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Core Relevance at the Air Force Academy

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Educating the Airman Scholar

Post-Cold War Applications of Air & Space Power

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From The Editor

Our feature article introduces our first of two topical foci: *Educating our future and current officer force*. Colonel Thomas Drohan, Department of Military & Strategic Studies (on sabbatical this semester), assesses the core education at the Air Force Academy and debates the merits of a more flexible set of choices in the core curriculum. This issue also includes our best cadet-authored capstone theses for the Military & Strategic Studies major and highlights their research accomplishments. Cadet Joshua Huckabee argues for improved simulation scenarios in the Cadet Battle Lab, DFMFI's premier networked classroom. Cadet Gordan Lang follows with his proposal for a joint military Cyber School to train the rising generation of Cyber warriors. From there, this issue focuses on post-Cold War applications of Air & Space Power. Cadet Joseph Shields argues the merits of weaponizing space. Of particular note is Cadet Brandon Shoenfeld's argument that the Air Force should buy the A-29 Super Tuscano as its next light attack aircraft, instead of the US-built AT-6 Texan II, also extensively used as an Air Force trainer. As this issue went to press, the Air Force announced plans to purchase the Tuscano's for use in Afghanistan; thus, Brandon's logic has proven sound. Cadet Vincent Jovene also makes an airframe argument in favor of a mixed purchase of CV-22 Ospreys as Rescue/ Recovery aircraft, rather than sole reliance on the less agile HH-60 Pave Hawks. Finally, our book review by Cadet Edward Boylan looks at Max Boot's work, *War Made New*, a text used in our core senior course.

ASJs mission is to feature topical and regionally-focused articles of interest to the military academic community. Both military and civilian academic faculty and staff are encouraged to submit articles for publication and nominate outstanding cadet papers. We also encourage reviews of military-relevant topics (see samples on page 41). Send all submissions in word format (with Chicago-style endnotes) to ASJeditor@usafa.edu

Table of Contents

Featured Article

1 Core Relevance at the USAF Academy
THOMAS DROHAN

Topical Focus: Educating the Airman Scholar

9 Active Learning and the Rising Generation of Air Force Officers
JOSHUA HUCKABEE

15 Hands on Keyboard: Considerations for a Cyber Weapons School
GORDAN LANG

Topical Focus: Post Cold War Applications of Air & Space Power

22 Siezing the Ultimate High Ground: Weaponizing Space
JOSEPH SHIELDS

29 An Airplane for All Seasons
BRANDON SHOENFELD

35 Personnel Recovery: CV-22 Expansion Pack
VINCENT T. JOVENE, III

Book Review

42 *WAR MADE NEW, BY MAX BOOT*
REVIEWED BY *EDWARD BOYLAN*



Core Relevance at the USAF Academy

The Professional Need for a Comprehensive Liberal Education

THOMAS DROHAN

Over the past decade, a reshaping of the core curriculum has been underway at the United States Air Force Academy (USAFA). First, robust academic majors and increased opportunities for cadet research are raising the academic expectations of core courses. At the same time, most cadets enter the Academy from a public education system in relative international decline. Second, USAF mission demands are pulling on the core, traditionally the broad foundation of a liberal education, to supply “total force competencies”¹ of immediate relevance to the profession. Enduring academic debates over educational depth and breadth are now sharpened by strident if not contradictory calls to develop more strategic thinking as well as deeper competence in science, technology, engineering and math. Third, learning-focused pedagogy and assessment have nudged core courses into deliberate development of 19 institutional learning outcomes (Academy Outcomes).

The Academy Outcomes appeal to social scientists and education administrators throughout the American Association of Colleges and Universities (AAC&U), and well resonate with effects-based and inspection-requirement frameworks that permeate Air Force operations. The Outcomes

consist of six knowledge-type outcomes (heritage and application of air, space and cyberspace power; national security and full spectrum of joint and coalition warfare; civic, cultural and international environments; ethics and the foundation of character; principles of science and the scientific method;

Core Thoughts

As if the core were malleable clay rather than sacred stone, software rather than hardware, reformists would sculpt a new form consisting of greater academic diversity and more individual choice. A USAF mission-

As if the core were malleable clay rather than sacred stone, software rather than hardware, reformists would sculpt a new form consisting of greater academic diversity and more individual choice.

and principles of engineering and the application of technology), eight skill outcomes (quantitative and information literacy, oral and written communication, critical thinking, decision making, stamina, courage, discipline, teamwork) and five responsibility outcomes (ethical reasoning and action, respect for human dignity, service to the nation, lifelong development and contributions, intercultural competence and involvement). These Outcomes, drawn from a bureaucratically-vetted blend of official USAF documents and an AAC&U public advocacy initiative in 2006,² are meant not only to meet mandated commissioning education standards but also to define the desirable characteristics of “leaders of character”³

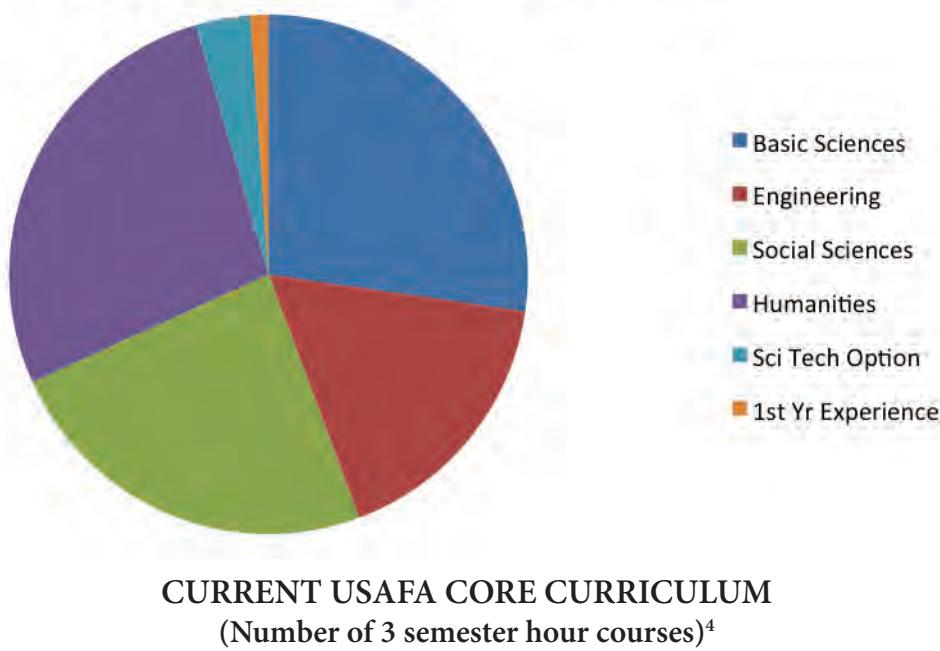
oriented architecture could be more flexible and defined not simply in terms of mandatory common courses (“core”), but also in terms of common choices (an “outer core” superimposed on an “inner core” [formerly “core”]), providing “multiple purposeful pathways” to the Outcomes. Advocates expect structured flexibility to better prepare cadets for the complex adaptive disciplines and dynamic demands of Air Force specialties. Such educational alignment at a military academy, all of which have signature large-core curricula two to three times those found at colleges or universities,

Colonel Thomas Drohan is Professor and Department Head of Military & Strategic Studies. This article was presented to the Inter-University Seminar on Armed Forces & Society, October 2011.

poses significant challenges to swollen schedules and an academic divisionally distributed core. The current core comprises 96 of the 141 semester hours of a cadet's education, a proportion that has stayed fairly constant over the past 30 years (USAFA was established in 1954).

Figure 1

USAFA's 33-Course Core Curriculum



BASIC SCIENCES

Biology-2, Chemistry-2, Computer Science-1, Mathematics-3, Physics-2

ENGINEERING

Aeronautics-1, Astronautics-1, Elec & Comp Engr-1, Engr (Systems)-1, Engr Mechanics-1

SOCIAL SCIENCES

Behavioral Sci-2, Economics-1, Law-1, Management-1, Political Sci-1, Soc Sci-1

HUMANITIES

English-3, Foreign Language-2, History-2, Military & Strategic Studies-2, Philosophy-1

INTERDISCIPLINARY

First Year Experience-1/3, Science and Technology Energy/Systems Option-1

When viewed from the perspective of post-World War II reforms that transformed US military academies into icons of liberal education still stuffed with valuable programs that distinguish them as four-year officer

commissioning programs (military, athletics, ethics), a more professionalized curriculum with academic choice constrained by Outcomes seems anachronistic. The prospect of a narrower core with fewer common courses generates considerable debate at USAFA, where the core is more prescribed than at West Point or

Since its inception, the core curriculum has attempted to clarify the distinctiveness of a military academy education — one that is professionally relevant and intellectually rigorous. As is the case with its armed services counterparts, USAFA complements other USAF commissioning sources' strengths, recognizing that Air Force Reserve Officer Training Corps (AFROTC) and Air Force Officer Accession Training School (AFOATS) can provide a more tailored and timely supply of officers. There are differences among service academy core curricula, including degree of individual choice, but all feature an exceptionally broad liberal education to prepare cadets for the unpredictable variety of challenges they will face as officers.

So strong was this founding assumption that when USAFA became the first US military academy to introduce academic majors (first as divisional additives from the core, then as departmental disciplinary offerings), they were justified as enhancements of the core. That is, academic majors were not established primarily to produce specialists, but rather to bring more academic rigor and breadth into the core experience. This early core contained what was referred to as the "professional nucleus," an inner core regarded as educationally important for any Air Force officer, to which each academic department contributed, and for which all departments were professionally responsible. Given the collective commitment to maintaining this commons, it was often remarked that the true major at the Academy was the core. This is not often heard today among serving faculty.

Figure 2



As the Air Force has expanded its missions beyond airpower to encompass air, space and cyberspace, the need for both a broader perspective and more specialized and integrated capabilities challenges service identity. Similarly for USAFA, the USAF's only commissioning program that must meet undergraduate accreditation requirements, this strategic complexity became a core issue. At a time when USAFA was called to improve its professional relevance and effectiveness, learning-focused assessment emerged as a way ahead toward accountable, professional relevance and effective academic rigor.⁵ This path would lead to new concepts for the core and its professional nucleus.

Enter Learning-Focused Assessment

USAFA's newfound emphasis on learning, rather than teaching *per se*, is related to the dual role of the core. Professional stakeholders wanted to know that Academy graduates internalized key qualities. In 2006, curriculum guidance flowed from the Superintendent to the Dean. Under the assumption that professional requirements needed to be balanced with those of a broad university education, a curriculum task force designed a system that would integrate the Academy's mission across aca-

demic, military, athletic and ethics programs.⁶

In an effort to improve Academy effectiveness, the Dean's Faculty Council meetings prepped and tasked departments to align core course goals with Outcomes, and to lead Nineteen cross-mission Outcomes Teams.

Professional shaping encountered limitations as faculty balanced educational priorities within the realities of an always full schedule of calls. Some Outcomes such as critical thinking and communication are handily blended into coherent lesson plans, while others such as intercultural competence and teamwork are more dependent on the compatibility of lesson objectives. Even critical thinking often needs to be tailored to an introductory learning level, such as acquiring basic computational skills before analyzing an engineering problem, or understanding the categorical imperative before discussing Kantian ethics in combat. Such disciplinary basics are not obvious at a strategic assessment level of diagrams or an operational level of course titles.

As learning-focused assessment Outcome Teams met and shared their course experiences, it became apparent that discipline-specific details of assessment and learning effectiveness were adequately appreciated only by those at the tactical level of teaching. This strategic-level blind spot was reinforced by the absence of such interdisciplinary majors common at other colleges and universities as neuroscience, anthropology, biophysics, public policy, human biology and the philosophy of science. Such content is being taught in USAFA

departments, but one would have to be in the disciplinary arena to know that. In contrast to the absence of these inter-disciplinary departments, USAFA does have profession-prompted majors in disciplinary specializations and multi-disciplines: Space Operations, Meteorology, Operations Research, Foreign Area Studies, Systems Engineering, and Military & Strategic Studies majors. In this environment, the expectations levied on the Outcomes Teams increased from assessing existing course content to reforming course content in order to expand the learning of a particular Outcome. This increased tension between two basic needs competing for time: institutional-level assessment rubrics and broad, deep disciplinary expertise.

The Air Force Academy's macro-alignment campaign continued, which led to the rollout of the Curriculum Outcomes Assessment Plan, or COAP (see Figure 3 next page).

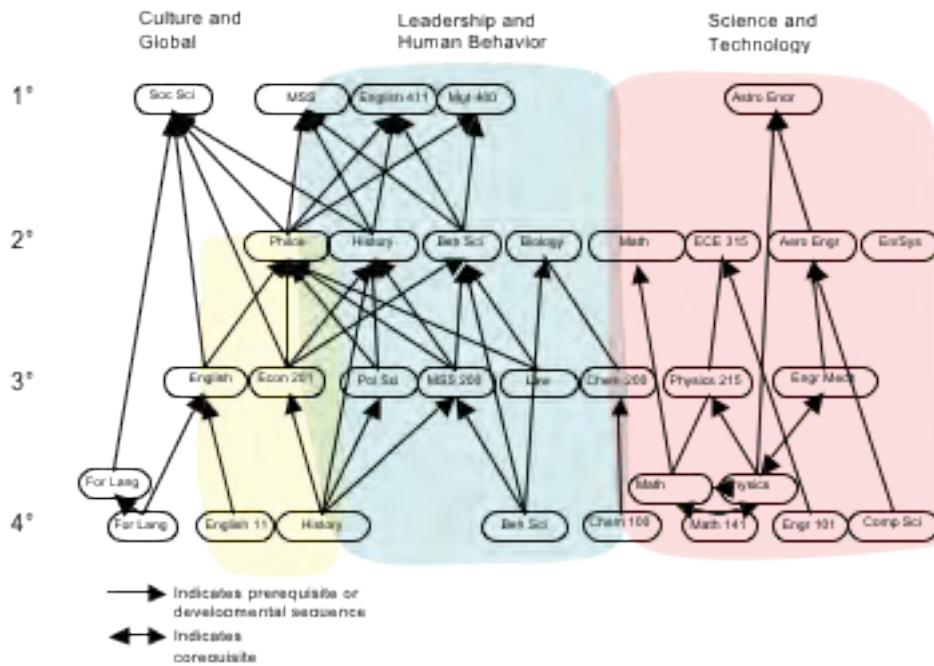
The COAP materialized from agendas organized to muster support for threading Outcomes through the curriculum, using the Outcomes Teams as tools. More a strategy than a plan, the scheme sought to establish an appreciation of the value of Outcomes, by laying bare the intentionality of the core curriculum. It is reasonable to assume that COAP advocates hoped to promote faculty-wide networks of learning throughout the multi- and cross-disciplinary core. But top-down and bottom-up perspectives mashed more than meshed. On the one hand, the COAP provided a visual representation of desired pre- and co-requisites to develop Outcomes

in a linear, sequential manner. On the other hand, restricting linkages and knowledge aggregates to pre-determined courses proscribed what was deemed to be professionally relevant and undercut educational creativity and richness.

The common Outcome-oriented, learning-focused assessment frameworks (Outcomes, Outcome Teams and the COAP) implied that there were alternatives to the traditionally disciplines-driven professional nucleus

Figure 3 The COAP⁷

CURRICULUM OUTCOMES AND ALIGNMENT PLAN



and common core cultivated by academic departments. This fundamental difference in how the Academy could improve (or prove) its performance became obvious as Outcome-oriented integration coincided with discipline-based insertion of content into the core.

On Alignment

Assessments of selected Outcomes in courses where actual

learning is not so restrained are slender strands of illustrative integration. If the faculty is to weave a meaningful fabric, then what is needed is a working concept of alignment that recognizes and advances the origins of Outcomes. Ideally, the understanding of Outcomes themselves should derive from a liberal education comprised of multiple disciplines, which spawn inter-disciplines and new disciplines. The intellectual power of disciplines and the interdisciplinary connections

restrict content to that which supports desired Outcomes, or targets. This may be for the purpose of forging a sense of common identity, or to meet stakeholders' requirements. An example of this approach is the use of Outcome Teams to promote the Outcomes, which has led to a resisted expectation that curriculum content will change accordingly.

Alignment could also be seen as drawing from a broad core that supports the Outcomes without being limited to them. This approach would view Outcomes as partial inputs, not independent seeds, of future Outcomes.

From this point of view, aligning a liberal education to Outcomes is problematic, especially if taken to extremes. The first example above could orchestrate a top-down "wire brushing" of the curriculum to ensure that all Outcomes are developed and assessed. This could be referred to as a "only teach outcomes" philosophy of the Efficiency School (similar to a well-focused training approach) with its omniscient "ergo propter hoc" fallacy. The second example could devolve in the opposite direction toward ad hoc selection of content to assess any particular Outcome. This might be the Random School's credo, "teach anything and everything and something surely will support Outcomes," which ignores the need for the Academy to actually teach certain professional content, such as those specified for USAF Commissioning Education Programs. We could expect the Efficiency School to suffer from structured conformity and Random School to be riddled with unanticipated gaps and overlap.

they foment then enables adaptation and anticipation of changes in the professional environment. My assumption is that education creates knowledge and any associated outcomes (intended or not) and processes from which Outcomes are derived.

From this perspective, curriculum alignment may be understood in at least two ways. It may be interpreted as a supervisory tool to

Consider the work of Colonel John Boyd, an approach to learning that depends upon aggressive inquiry and the discovery of knowledge. Boyd's fighter pilot sequence of Observe - Orient - Decide - Act, or "OODA loop," is a practical process of creative learning with broad situational awareness and constant feedback. In a context of air-to-air combat (which Boyd experienced during the Korean War), the OODA Loop fits nicely into the Efficiency School (random flying would tend toward undesirable outcomes). However, as Boyd applied his combat tactics to strategic questions, he developed general arguments in presentations such as *Discourse on Winning and Losing, Destruction and Creation, and Patterns of Conflict*. Boyd's incisive inquisitiveness crossed disciplinary boundaries as he synthesized perspectives from organizational learning, cybernetics, autopoietic models and chaos theory. External knowledge was permitted; the OODA Loop is not a closed circuit. By seeking out various forms of knowledge, Boyd was able to improve historical fighter tactics to create an energy maneuverability theory still evolving today well beyond air-to-air combat applications.

Similarly, a field of study's content and process knowledge, irrespective of any Outcomes, is critical to educational development. Now let's compare Boyd's construct with USAFA's Learning Development Model (LDM), currently a widely-used process.⁸

The LDM schematic is strikingly similar to Boyd's OODA Loop except for one important respect (see Figure 4 above right).

Both models aim to represent a process more complex than targeting and re-targeting desired outcomes, and rely on knowledge outside their self-constructed systems. Each presumes to adapt to internal changes and admit external stimuli. The major difference

Two further examples support the idea that educational alignment should further the unrestrained growth of academic knowledge: bounded rationality and uncertainty. In Rubenstein's concept of bounded rationality, humans intend to pursue goals rationally

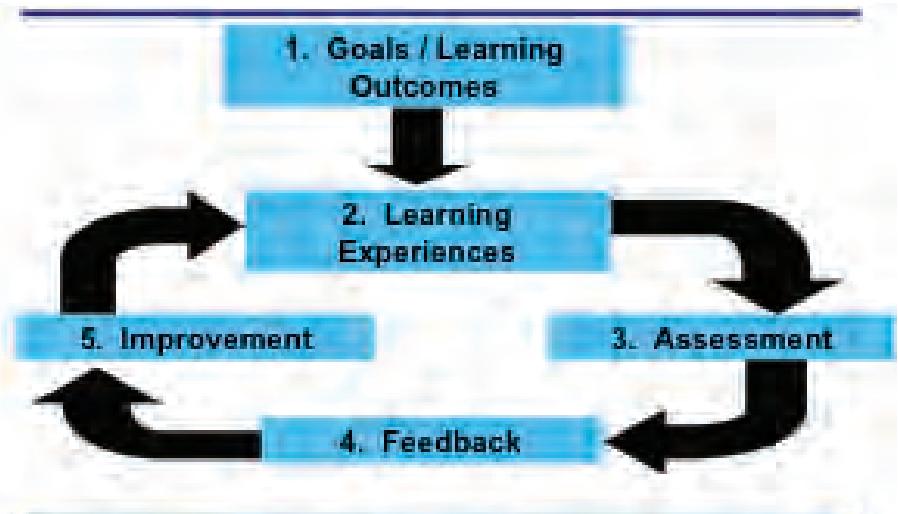


Figure 4 USAFA Learning Development Model (LDM)

is that Boyd's assessment methods step occurs after feedback (in the Orientation phase), not before it as in the Learning Development Model (LDM). In theory, Boyd's OODA Loop allows for broader situational awareness and more forms of external stimuli, rather than feedback-free assessment. Similarly, professional intelligence analysis prescribes a requirements-focused process that continues to analyze information before knowing how the information will be collected. That is, analysts are not supposed to filter out potentially significant data with desired collection Outcomes, because such alignment could cripple the understanding of complex operational environments.⁹ Whether fighter pilot or intelligence analyst, competitive learning requires models that promote creative, innovative and highly interactive processes of discovery.

and adapt to achieve them, but based on our limited information, time, and abilities to understand the environment, we "satisfice." Therefore, we need to seek knowledge outside the fundamental elements and relationships that constitute our modeled systems (including Outcomes) and assess our learning after broad feedback (not before it). Let's assume that we need to out-compete clever, smart, cunning and highly motivated adversaries. This implies that the broad knowledge base comprising our source of current Outcomes needs to be acknowledged, valued and protected, because knowledge is the culture from which future Outcomes grow.

Content knowledge is important, even when not deemed to be professionally relevant to current Outcomes. An interpretation of Heisenberg's Uncertainty Prin-

ciple makes a similar point. Take a potential target as an example. The smaller the aperture of a single

endpoints are training on one end and education on the other, with variable methods and purposes.¹⁰

If Academy educators are to actively create knowledge rather than passively observe or translate it, then we need to be unrestrained by pre-determined Outcomes.

optical sensor on a target, the less likely we are to know about its movement, and the more we know about a target's location the less we know about its mobility. In the case of human intelligence, attributing intent and accounting for random behavior is even more difficult. Ideally we'd like multiple sensors and sources, but we are constrained by various resources so there will always be an element of uncertainty in our knowledge no matter how sophisticated the technology. If we accept this principle, then we need to allow uncertainty in our outcomes so that any Outcome does not exclusively determine what we judge as relevant to teach and research.

Conclusions

The development of knowledge, skills and responsibilities is vital for an accredited institution of higher learning whose social value to the nation is to be at once a professional and academic program that commissions military officers. The profession of arms is a most competitive enterprise with critical consequences, so USAFA must strive to be value-added with respect to the alternatives in the American educational system. The USAFA core experience should be more than mission elements independently pursuing military training and academic education respectively. Learning tends to operate along a spectrum whose

So the Academy's Athletic Director, Dean of the Faculty, and Commandant of Cadets lead proportionally different mixtures of training and education knowledge, skills and responsibilities. Knowledge in particular is exploding far too quickly for any specific Outcome to competently direct. Therefore, Outcomes at the institutional level are needed, but they need to be as general as the mission permits in order to empower liberal education as the main engine of professional Outcomes.

If Academy educators are to actively create knowledge rather than passively observe or translate it, then we need to be unrestrained by pre-determined Outcomes. Outcomes cannot be updated often or precisely enough compared to what is going on in dynamic fields of study, research, courses and lessons. The reification of knowledge Outcomes and resultant analytical categorization of sub-tiers to be assessed, does not equate to all relevant knowledge. Such a calculus would be particularly deadly to innovation and creativity, because unlike skills and responsibility Outcomes, knowledge Outcomes are *a priori* limits to knowledge.

At the same time, USAFA needs to actively lead, not simply be accountable to, commissioning education requirements. Professional relevance is the *sine qua non* of an Academy educa-

tion, which is not to downplay the need for intellectual rigor. To the contrary, given the globally competitive nature of the military profession, an Academy's professionally relevant academics need to be first-rate. USAFA faculty participation in the USAF Commissioning Education Program is a vital aspect of core relevance as this collaboratively determines the outcomes that should be integrated into every USAF commissioning curriculum. Strong embracement of this program by USAFA academic departments helps ensure professional requirements are relevant and rigorous, and met.

Faculty do teach material that does not align particularly well with any of the Outcomes, but teach it anyway using judgment in addition to organizational templates. The Department of History, for instance, has steadfastly taught counterinsurgency as part of its History of Unconventional Warfare course since the 1960's through the post-Vietnam period of doctrinal stagnation (only rejuvenated since 9/11). Similarly, the Department of Military & Strategic Studies taught interagency and irregular operations years before service and joint doctrines changed and before USAFA's knowledge-type Outcome, "the full spectrum of joint and coalition warfare."

By venturing outside established boundaries of professional education, yet ensuring we meet such requirements, we encourage cadets and ourselves to develop and defend innovative arguments. Multiple disciplinary approaches to knowledge can provide any number of pathways to Outcomes, but they also lead to places only discovered along the way. A curric-

ulum bounded by Outcomes may be adequate for a vocational school charged with developing currently needed skills. But an education for world-class military officers needs

practical development of human capacity to lead (students and faculty alike).

Disciplinary approaches to knowledge creation provide dif-



to be balanced to participate in the creation of the Outcomes.

A research and teaching enterprise should nurture the freedom of the mind to encourage department-level adjustments of its curriculum to support Outcomes, rather than to align by enforcing the curriculum to fit Outcomes. Faculty members may not intend to trim a course or lesson to Outcomes only, but it tends to happen in a structured approach. Moreover, Outcomes can drive research priorities in the competition for funding. If faculty think that liberal education is a process that creates knowledge for knowledge's sake, then the departments charged with exercising professional and academic judgment about relevant content is where liberal education must be deliberately nourished. Liberal education is not just theoretically robust; it is also quite

ferent perspectives and creative methods of learning, tempered by the humility that no single discipline always has the best answer to knowledge creation. Interdisciplinary approaches draw from the richness of disciplines, which is how a well-developed core of disciplines provides a creative intellectual foundation. We need robust discipline-based knowledge to have well-informed, quality debates over breadth and depth, majors enhancing the core and the core building majors, professional and academic balancing, and so forth, in the first place. A broad core foundation can support what will surely be a continuing complexity of Outcomes (air, space, cyber, what's next?) without being utterly defined by them. We need to approach Outcomes from disciplinary and derivative interdisciplinary perspectives which embrace teaching and assessing

content that includes what we may sometimes judge as professionally irrelevant but academically rigorous for educational learning.

Fundamental assumptions about the origins and creation of knowledge matter. By preserving a broad, multiple discipline approach to achieving professionally relevant Outcomes, we can better ensure that such Outcomes will continue to be derived from fundamental questions rather than final answers.

1 An Air Force Learning Committee, part of the HQ USAF Force Development Directorate, was established in 2007 and regularly updates the USAF Total Force Competency List. This effort was predicated by a series of USAF committees and conferences in which USAFA faculty have been involved since the mid-90's. A short list includes the Learning and Education Council, the Commissioning Training and Education Committee, and the Developing Aerospace Leaders initiative, whose "Mastery of Aerospace Power" competencies and components matrix developed into today's competency list.

2 Eight "strategic documents" were used to develop the Academy Outcomes in 2006: AFDD-1, Leadership & AF Development; American Association of Colleges & Universities LEAP Outcomes; AFI 36-2014, AF Pre-Commissioning Education; AFMD-12, USAFA; USAF Total Force Competency List; AFPD 36-35, USAFA; AFI 36-3502, Performance Measurement Program for USAFA; and the USAFA Mission and Vision statements.

3 USAFA Mission Statement: To educate, train and inspire men and women to become leaders of character, motivated to lead the United States Air Force in service to our nation; USAFA Vision Statement: to be the Air Force's premier institution for developing leaders of character.

4 United States Air Force Academy Curriculum Handbook 2011-12, Office of the Associate Dean for Aca-

demic Affairs, 74, <http://www.usafa.edu/df/dfr/curriculum/handbook.cfm?catname=dfr2>,

5 The first two recommendations of the Larson Report, a National Defense Authorization Act-directed Secretary of the Air Force task, were as follows: R1.T his study highly recommends that the Superintendent, in coordination with senior Air Force leadership, establish a common mission statement for the Air Force Academy that reflects the needs of the Air Force. R2. One of the most important things to be done at the Air Force Academy is to improve the integration of the three mission elements. Adm (ret) Charles R. Larson, Study and Report Related to Permanent Professors at the Air Force Academy, April 2004, 55.

6 The increase in accountability to standards across all mission elements at the Academy (military, academic, athletic, ethics) is illustrated by the addition of an institutional-level Physical Education Review Committee in the early 2000's. The PRC, like its predecessors the Academic Review Committee and the Military Review Committee, judges cases of cadets failing to meet mission element standards, oversees

rehabilitation, and recommends retention/disenrollment. The Cadet Honor system is a different process as it has been proudly owned and run by cadets. However, it is bureaucratically conceivable that assessment-oriented research on character and ethics could lead to the implementation of screening metrics for college and university applicants

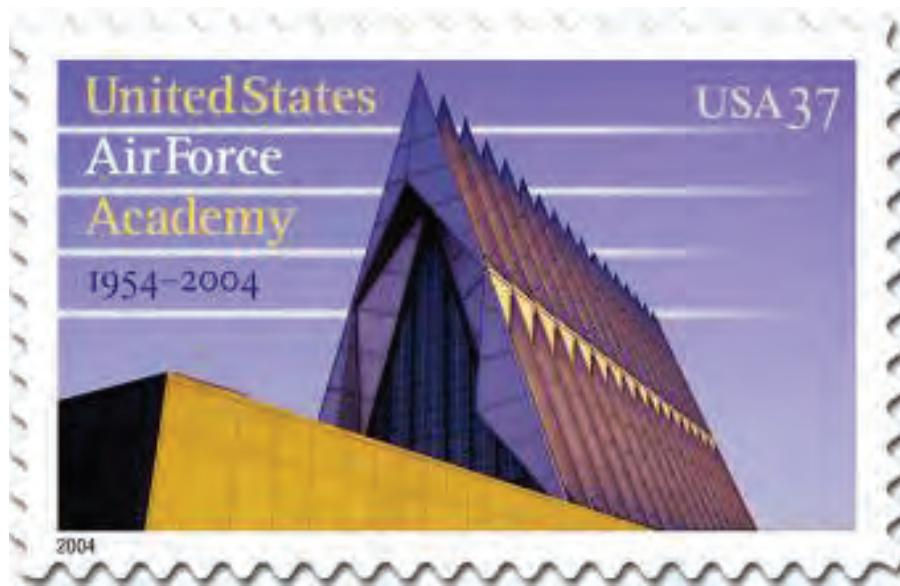
7 United States Air Force Academy Curriculum Handbook 2011-12, Office of the Associate Dean for Academic Affairs, 75, <http://www.usafa.edu/df/dfr/curriculum/handbook.cfm?catname=dfr2>,

8 "Guide to Learning-Focused Practice: Rubrics for Self-Assessment and Curriculum Development," May 2006, Directorate of Education, Dean of the Faculty, USAF Academy. This working paper is one example of learning-focused ideas that contributed to what became referred to as the Learning Development Model. Beginning in 2000, officer development under the Commandant started to be formalized with Commandant Learning Outcomes and related to the Dean's Educational Outcomes. In 2004, new learning constructs and models were incorporated into the newly established Officer Development

System. At the strategic level were the Academy Outcomes, at the operational-level the PITO (Personal, Interpersonal, Team, Organizational) Flight Plan, and at the tactical-level the Leadership Growth Model.

9 Analysts "should not quit the decomposition process because they do not know how the resultant observables might be collected against." Wayne Michael Hall and Gary Citrenbaum, Intelligence Analysis: How to Think in Complex Environments (Oxford: Praeger Security International, 2010), 91.

10 Education: (a) developing intellectual capabilities based on broad principles or guidelines (b) to understand or explain (c) relatively ill-defined situations and problems. Training: (a) engaging in disciplined practice according to specific principles or guidelines (b) to reach decisions or perform tasks (c) in more recognizable situations and problems. Quoted from Tom Drohan and Doug Murray, Responding to the "Developing Aerospace Leaders" Initiative, Aerospace Power Journal (Summer 2001), 13-22.



ACTIVE LEARNING AND THE RISING GENERATION OF AIR FORCE OFFICERS

AN INCORPORATION OF NEW SIMULATION TECHNOLOGIES AND SIMULATIONS FOR THE CADET BATTLE LAB

JOSHUA HUCKABEE

Technology has had a transforming impact on military education. Michael Macedonia, the Chief Scientist and Technical Director of the US Army Simulation, Training and Instrumental Command (STRICOM), states that “Modeling and Simulation are considered essential to military transformation—the retooling of armed forces for the new realities of the 21st century. These tools present a powerful way for military leadership to visualize the future and assess needs.”¹ Using new technologies is essential to increasing the depth of education in many learning environments. One such environment that employs “state-of-the-art” education technologies is the

This essay will explore new alternatives for simulation in the CBL by drawing on research about new and innovative technologies that can be employed to foster a more engaging learning experience for cadets. To that end, this paper will seek to answer the question: how can one best implement new technologies for use in the CBL?

Learning laboratories generally need to be able to accommodate innovative change in order to promote the most effective learning strategies. One problem that arises is how to approach the implementation of rapidly evolving state-of-the-art technologies. According to Michael

tion of these new technologies by the University of Phoenix and the US Army’s eArmyU exemplify an innovative approach to learning that has been extremely successful. Michael notes that “eArmyU is an online army college where technical training can be accomplished. It also serves as a means to higher military learning.”³

A related issue that arises is how to choose a state-of-the-art technology that makes the best use of a given learning environment. In the case of the MSS CBL, once selected, that state-of-the-art technology needs to be appropriately integrated into CBL-based activities in a way that promotes innovative learning-focused and engaging simulation exercises. By drawing on proven ideas, a simulation tailored to time-constrained DFMI faculty and cadets can be crafted that will result in a stimulating learning environment. The simulation proposed here is the Cadet-Engaged Strategic Simulation (CESS). CESS is offered as a model-focused approach that could be

Modeling and Simulation are considered essential to military transformation—the retooling of armed forces for the new realities of the 21st century. These tools present a powerful way for military leadership to visualize the future and assess needs.

US Air Force Academy’s Department of Military & Strategic Studies (DFMI or MSS) and its Cadet Battle Lab (CBL). Properly employed, the CBL has the potential to encourage the development and implementation of new and innovative learning strategies.

Macedonia, “Traditional universities face major competition from non-traditional organizations such as the the University of Phoenix and the US Army’s eArmyU that employ disruptive technologies and techniques such as distributive learning.”² The implementa-

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considered for implementation in MSS core courses. Furthermore, it could also serve a dual-use as the basis for an iterative capstone project for MSS majors. For example, cadets majoring in MSS could choose between completing a traditional paper or undertaking a CBL-related capstone project involving further refinement of the proposed CESS simulation.

Implementing new state-of-the-art learning environments in educational institutions is extremely beneficial and has the potential to provide a more effective way of learning. Moreover, facilities such as the CBL are capable of accommodating a multitude of potential state-of-the-art education technologies. Accordingly, a key issue involves identifying which learning simulations will provide the desired outcome in the demanding, time-constrained environment of the Air Force Academy. Bassem Alhabi, a professor of technology at Florida Atlantic University, acknowledges this issue when he notes, "Despite ceaseless investments in emerging technologies by U. S. institutions of higher education, few questions have been raised as to whether these technologies are truly essential to support instructional and overall educational goals."⁴ While it is beneficial to have the capability to host a multitude of innovative learning-focused simulations, employing the wrong one can hinder progress to improve innovative learning. Not only may the innovative technology fail as a learning tool, but resources will be

wasted as well. Thus, it is important to draw on technologies employed successfully in other institutions and tailor them to Academy needs. In part, these include the time-constrained environment, in which both cadets and instructors must function. Simplicity of operation thus becomes vital, although it must be recognized that the more simple a simulation is, the less fidelity it will possess. Accordingly, there is a tradeoff between simplicity and fidelity that needs to be reorganized and balanced carefully. The guiding philosophy of the CESS seeks to strike that balance.



When dealing with state-of-the-art education technology, usually very little experience exists about how to use and support that technology most effectively. Put simply, there is always a high chance of failure when dealing with innovative ideas. With a system that is too complex, a lack of relevant technical expertise may result simply in an expensive failure. It is important to keep the system simple, a principle that has informed the concept being proposed here. In this paper, various simulations will be ana-

lyzed in order to make the case for the CESS and why it should be adopted to augment current simulation technology employed in the CBL.

Employing state-of-the-art technology in the Cadet Battle Lab (CBL) for innovative learning-focused simulations can best be accomplished in three sequential steps: (1) an analysis of state-of-the-art simulation technology and trends must be conducted in regards to the Academy's academic mission; (2) The state-of-the-art technology must satisfy the

learning-focused philosophy that justifies the existence of the Cadet Battle Lab as a tool for facilitating learning within the time limitations of the cadet schedule; (3) The state-of-the-art technology must be capable of functioning with the expertise that is available in DFMI. In regards to the first step, there are many potential technologies that pertain to education simulations and engagement. One such medium is adding visual media to simulations and engage learners. In regards to the second step, "virtual worlds" (i.e., artificial environments) are domains that can be created to simulate any learning objective. The use of associated technology can promote the desired learning outcome of Military and Strategic Studies by increasing the strategic mindset of cadets in a way that engages them and inspires their participation. This could be accomplished by simulations that can be manipulated easily, such as a decision simulation where students must act quickly in reaction to a simulated

nuclear attack. In regards to the third and final step, virtual worlds are user friendly. This means that special technical expertise is not required to employ this system for instructional purposes. A virtual world is a viable solution to the argument presented in the thesis. For example, cadets could have the ability to participate in simulations anywhere in the world; that is, students could access terminals via their smart phones or computers and participate in a virtual class. This is important because students could continue learning outside the classroom, not merely when a traditionally rigid schedule dictates they must. That, in turn, could promote a greater motivation for learning. Before making the case for the proposed CESS, some background on the use of technology in military education may be useful.

It is important to understand the future of state-of-the-art tech-

Grissom makes a further noteworthy comment when he observes that staying ahead in all technical aspects of warfare, to include the learning environment, serves as a significant security measure. In his conceptual framework, Grissom describes state-of-the-art technology as the highest process of learning in a field that contributes to a scientific revolution. In *The Structure of Scientific Revolutions*, another author, Thomas Kuhn, writes that the accumulation of anomalies within a field of research creates, over time, pressure for change in the field's prevailing assumptions and conceptual frameworks.⁶ This means that state-of-the-art technology is defined as a reform that is at its highest stage of development and with time creates a revolutionary outcome. In essence, the key to a revolutionary outcome is creativity. For example, in World War II the Germans created the blitzkrieg by forming new link-

have made. This can best be fostered by allowing cadets discussion time and enabling them to see the results of their decisions by more fully exploiting the CBL's projection capabilities. Also, as a capstone, cadets must improve upon the framework that is the CESS forcing elaborate research and critical thinking. A more detailed explanation will be provided in the following pages.

As we shall see, the CESS is built upon a historical foundation of successes in previous simulations. The history of implementation of state-of-the-art technology in military environments gives a baseline of what has been successful and unsuccessful. That, in turn, can be of assistance in determining the appropriate new technology for the CBL. Chris Dede, a professor of learning technologies at Harvard's Graduate School of Education, provides great insight about how learning technologies have been employed to promote learning. Historically, knowledge was transmitted by word of mouth and by lecturing. Since the dawn of computers, computational tools have been employed to create a much more active and "well-rounded" learning environment. Simply put, as technology has advanced so has the level of detail and realism of simulations. Dede notes, "To date, uses of information technology to enhance constructivist learning environments have centered on creating computational tools and virtual representations that students can manipulate."⁷ State-of-the-art education technology can be expected to advance the overall effectiveness of learning as well. In that regard, Dede goes on to state, "As learners interpret experience

Staying ahead in all technical aspects of warfare, to include the learning environment, serves as a significant security measure.

nology in order to determine which technologies can best be implemented to support a positive, proactive learning environment for the CBL. Adam Grissom of the RAND Corporation provides great insight about the application of state-of-the-art technology in his monograph about the future of military innovation. He states, "Innovation and stagnation have been important themes since the earliest writings on warfare."⁵ Innovation is key in the case of simulation technology, and stagnation of our current simulation methodology must be avoided.

ages of two existing ideologies in different ways. German tanks were used in an innovative fashion. These tanks were used essentially as cavalry instead of being devoted exclusively to infantry support. This was made possible by using radios. Ultimately, linking tanks, cavalry tactics and radios creatively was fundamental to the blitzkrieg's success. It takes a high level of creativity to accomplish feats such as the blitzkrieg. Similarly the CESS can serve as a creative device for engaging cadets and promoting "outside the box" thinking by allowing them to see the effects of the decisions they

to refine their mental modes, computational tools that complement human memory and intelligence are made available.”⁸ Thus, the use of state-of-the-art technologies can be expected to accelerate the effectiveness of the learning environment, providing another set of future technologies to further advance learning. It’s a continuous cycle that needs monitoring to keep promoting the use of new types of learning material in order to avoid becoming complacent with the technology that is already in use.

The process represented by the blitzkrieg and the history of educational technology both represent innovative approaches. If creating new linkages in military technology promoted the success of blitzkrieg-style warfare, then creating new linkages in education technology should also foster success. Linking multi-media, visual aesthetics and mass communication technology will appeal to cadets and promote simplicity for instructors. As noted above, this is a fundamental intent of the CESS. Among the US armed forces, the Army has realized that creating linkages appealing to the younger technocratic generation can create a successful training, engaging and recruiting simulation. “The Army Game,” as it is called, is in the form of a game for platforms such as X-box that promotes certain goals for the Army, chief among them recruitment of high school and college-age youth. It has been a huge success. The Army understood the power of engaging simulations and used linkages of different simulations to create the successful recruiting tool that they have today. Among its strengths is the fact that the Army

Game appeals to the user rather than the teacher. The point here is that a successful simulation must be appealing to the students, to include Air Force Academy cadets.

Future technologies need to be examined to determine how they can best be implemented into the CBL. Another author, John Gibbons, states, “The military has been a leader in the development and use of instructional delivery

tion labs, state-of-the-art computers for advanced simulation and a three projector system mimicking actual Air Control Centers used in the operational Air Force. The CBL is an Academy laboratory run by the Department of Military & Strategic Studies to teach, test, and evaluate Air Force Academy cadets as they learn to formulate military strategy. It has its own virtual world that can house a variety of imaginable situations. Accord-

Students of today live in a completely different world than their predecessors. Understanding touch screen, gaming and other visual mediums is second nature to cadets and younger officers. The point here is that visual stimulation should be stressed in order to foster an already high level of affinity for visual learning.

systems having used high technology for many years. Its great need for technical skill training, together with the critical nature of its national security mission and its nonprofit orientation, has led to a training technology revolution and a good market for state-of-the-art technology in military education and training.”⁹ The military is far ahead in learning technology and needs to stay ahead by implementing concept state-of-the-art technologies to create the next step in innovative learning. The foregoing discussion points out the importance of simulations in the military. The question for now becomes this: how can we make the most of the CBL as a resource for simulation-based instructing and learning at the Air Force Academy?

The Cadet Battle Lab

The CBL can support a myriad of learning activities and includes two sound proof battle simula-

ing to the DOD Joint Warfighting Center (JWFC) and the Training Development Group (TDG), (both leaders in virtual world simulations), virtual worlds are “an innovative blend of social networking and gaming technologies. Users are able to create personas known as avatars that can interact with each other in computer-generated three-dimensional environments, which in some cases are accessible 24 hours a day, seven days a week.”¹⁰ The CBL can be completely shut off from the rest of the world and virtual simulations can be conducted in an unrestricted way without creating problems for outside systems. It has the ability to be closed or open to the network at USAFA per instructor desires. For example, a virus can be released in the CBL to simulate a foreign cyber-attack. In the closed CBL environment the instructor can use emails embedded with a virus in order to train personnel in Operation Security (OPSEC). Overall,

the capabilities inherent to the CBL provide faculty and cadets with a highly potent visual learning tool. That's because junior officers and cadets alike are media-oriented and technologically-adept. Therefore, increased reliance on media-based learning can be expected to engage cadets and serve as a more effective training tool.

Visual Media in the CBL

Visual learning has had a profound effect on students since the early days of television. In World War II, the First Motion Picture Unit (FMPU) was created in order to test whether soldiers could be trained by means of visual media. Such a training technique ultimately proved to be a huge success. In the words of one historian, "Approximately a year and a half before the War, Warner Bros. Studios was contacted by the Army Public Relations in Washington with an official request that a series of short subjects be made, released in theaters throughout the country, for the purpose of orienting the public with the various branches of the military."¹¹ Since the days of World War II, students have become accustomed to be stimulated by visual cues. Practically all training now relies on visual techniques. This includes job training. To cite just one example, on their first day at McDonalds, new employees are required to sit in front of a television and receive visual training. Students of today live in a completely different world than their predecessors. Understanding touch screen, gaming and other visual mediums is second nature to cadets and younger officers. The point here is that visual stimulation should be stressed in order to foster an already high

level of affinity for visual learning. Accordingly, one application for the CBL would be to visually depict decisions and the repercussions of those decisions. If augmented by appropriate historical film footage, the visual classroom environment of the CBL increases the prospect of cadets remembering what they had been taught beyond the classroom.

The Cadet Engaged Strategic Simulation (CESS)

As envisioned here, the CESS will begin by introducing the scenario to its participants. The simulation will feature fictional countries and situations. The reason for fictional countries is that national countries and scenarios are less likely to become obsolete. The simulation could start with a fictional antagonist country, Blueland, releasing an address threatening the democratic nation of Redland. The government of Blueland might be assessed to desire a hegemonic status upon the color continent. Having set the stage, Red vs. Blue cadet teams will then be organized. United States, Redland, Blueland, and NATO, or other appropriate regional teams could be assembled. At the beginning of the simulation a presentation utilizing real life media and visual technology would capture the interest of CESS participants. One approach would be to use actual historical footage of an appropriate conflict and related news articles adapted as necessary for the simulation. Coupled with pronouncements from various key government leaders from the United States, allied partners, Redland and Blueland, this approach could be expected to promote active cadet participation. The benefit of using

fictional countries is that you can feature material pertaining to real world leaders whose names have been changed. The fictional aspect of the CESS also allows it to be much more adaptable. To incorporate a useful dimension of simulated fog and friction of this simulation, simulated personalities and personal agendas could be assigned to the various cadet participants.

There could also be a news agency consisting of several cadets where reporting might intentionally be biased toward either the governments of Blueland or Redland. Information biased toward one side or the other demonstrates that public media can be biased and encourages cadets to sift through the biased news reports for real facts. Media plays a major role in information operations as well as public affairs. Thus, it becomes important for cadets to understand the role of media and how propaganda can be employed in potential and actual conflicts. The media influence should promote additional discourse among decision-makers on both sides and can be expected to increase the complexity of the crises situation. Furthermore, communication between cadet participants implemented by the CESS utilizes new technologies. To facilitate media transmissions, CESS could employ Text/Twitter technology as well. This would allow instructors to text all participants in regard to upcoming situations, which gives them time to think of alternative strategies. The larger point is that Text/Twitter technology would enable instructors and cadets to engage in CESS-related activities outside of normal class time and outside the

confines of the CBL.

CESS exercises could be organized into phases drawn out over several lessons when sufficiently complex. Phases might include: “Analysis and Psychological Operations Phase,” using psychological operations to win the hearts and minds of US friends and foes. To that end, media influence and propaganda could be utilized by both teams. A “Diplomacy Phase” could be aimed at influencing diplomatic relations between Redland and Blueland, or multiple players. Options in this phase range from treaties, embargoes or sanctions that can be placed by the primary actors, or others, such as US or NATO teams. Once an option has been selected, the cadets will see the results and effects of their decisions by means of visual media. A third phase option would be the “Action Phase”. This could begin on the second or subsequent lessons and focus on the kinetic side of operations. The choices here would range between kinetic or non-kinetic military or other instruments of power. For example, if the cadets argued for diplomacy, the end result could be a stand-down of military forces and they might see newscasts of the Redland leader shaking hands with the Blueland leader. In this phase, each option could result in additional options, ultimately creating a tree branch of possibilities. Although it may sound complicated, the instructor would select the desired/negotiated option and the scenario could alter toward a new set of variables. As the simulation unfolds, cadets discuss and make a decision based on the options provided in “Action Phase”. A final “Conclusion Phase” would conclude the

simulation based on the previous inputs and discussions, where participants present their findings and their takeaways in an After Action Report (AAR) format.

As explained above, the CESS will be guided by the instructor and make increased use of the CBL’s visual capabilities. It is arguable that realism is proportional to participation. Actually seeing the results of the decisions the participants make in real time will foster a greater degree of active participation and enhance the retention of course objectives even after the class has been concluded.

In conclusion, the Cadet Battle Lab is a first-rate facility for conducting war-games and simulations. It can accommodate various kinds of simulations and, thanks to its inherent adaptability, simulations can be offered that involve increasing or decreasing levels of complexity. The sophisticated multi-media capabilities of the CBL constitute a particularly impressive engagement opportunity for cadets from a visually-oriented generation.

tary Innovation Studies (Washington, DC: RAND Corp, 2006), 2.

⁶ Thomas S. Kuhn, *The Structure of Scientific Revolutions* (Chicago: University of Chicago Press, 1962), 1

⁷ Chris Dede, *The Evolution of Constructivist Learning Environments: Immersion in Distributed Virtual Worlds* (Fairfax, VA: George Mason University, 1996), 165.

⁸ Ibid., 166.

⁹ John Gibbens, ed., *Information Technology and its Impact on American Education* (Washington: US Government Printing Office, 1982), 246.

¹⁰ Joint Warfighting Center Training Development Group, Analysis Division, “Virtual Worlds,” paper presented at NORTHCOM Simulation Conference, Colorado Springs, Colorado, September, 2008).

¹¹ George Siegal ed., “Hollywood’s Army,” The California State Museum collection (2010), 1.

¹ Michael Macedonia, *Games, Simulation, and the Military Education Dilemma* (Washington, DC: EDU-CAUSE Publications, 2002), 159. One example of state-of-the-art education technologies is Twitter, which provides a simple information highway that uses messaging to inform and teach anyone with a cell phone.

² Ibid., 157.

³ Ibid., 156.

⁴ Bassem al Halabi et al., “Technology and education: between chaos and order,” *First Monday* (peer-reviewed journal on the internet 1999), 1, http://131.193.153.231/www/issues/issue4_3/hamza/index.html.

⁵ Adam Grissom, *The Future of Mili-*

HANDS ON KEYBOARD

CONSIDERATIONS FOR A CYBER WEAPONS SCHOOL

GORDON LANG

The United States Air Force has recently taken great strides in establishing an effective cyber warfare component. Nevertheless, there remains a significant amount of work to fully integrate the cyber mission into the institutional Air Force. That effort includes the need for a well-developed Cyber Weapons School (CWS) to provide graduate level training and serve as the Air Force's cyber training flagship organization. The question this paper attempts to answer is how this proposed Air Force Cyber Weapons School should be structured in order to develop highly effective network warfare specialists.

Networks and cyberspace are crucial in nearly every current Air Force mission and can be expected to have an increasing role to play in the future. For example, Remotely Piloted Vehicles (RPVs) in current conflicts are assuming combat roles; the link connecting the plane to its pilot halfway across the world is entirely within the cyberspace domain. As the Air Force increases its RPV inventories and expands their roles, peoples' lives and the success of the mission could hinge on the security of the link between RPV and pilot. Other operations, such as intelligence gathering, information security, defense of energy grids, and surface to air missile targeting are all highly integrated into cyberspace networks.¹

There is currently a cyber training squadron attached to the Air Force Weapons School at Nellis Air Force Base, but given the major focus and culture at Nellis, cyber operators likely are not primary focus of attention, and their mission calls goes beyond the traditional battlespace.² While the Weapons School at Nellis is focused on, "achieving battlespace dominance" in a typical kinetic warfare sense, there are many functions of network warfare that operate independently of physical battles.³ This traditional focus of the Weapons School at Nellis could marginalize uniquely cyber missions at the expense of assisting kinetic operations.



This essay provides an alternative possibility to remedy this issue. It is concerned with developing a basic blueprint, or outline, for how this new, or rejuvenated CWS should be developed. Various academic issues will be addressed, such as the content and length of the curriculum and how best to achieve the overall objectives of this education. This study is not intended to provide a detailed, lesson-by-lesson syllabus for the school.

This paper will offer a number of contentions. First, the proposed Cyber Weapons School does not have to be built completely from scratch. Three current weapons schools will be evaluated in an effort to find a ready-made baseline on which to model the new CWS: the Air Force Weapons School, the Navy's Top Gun, and the Army Ranger School. Each of their basic frameworks will be drawn upon; in particular, curriculum content, teaching techniques, as well as standards for evaluating and managing students. Second, the major unique dimension of cyber operations will be considered; i.e., the fact that almost every new attack involves methods even an experienced operator has not yet seen. It will be argued that the solution to this problem requires that the CWS must promote independent, quick, and intelligent decision-making by its students. In order to achieve these important outcomes, a general outline of the CWS

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program will be offered. What is envisioned is a three month-long course that addresses all three subsets of cyber operations in an environment that is stressful and mirrors what operations against

great effect. Cyber operations are one of the fastest changing fields in the military and new ideas and methods are constantly required to remain competitive. By leveraging CWS graduates as prime-instruc-

Like an infantryman, a cyber operator conceivably could be engaged in continuous combat for extended periods. Ranger School simulates this by creating an overarching war game-type mission within which the students must function. The Air Force Cyber Weapons School should take a similar approach.

an intelligent and capable enemy might actually look like.

Similarities of the CWS to Current Weapons Schools

Weapons schools are nothing new to the United States military so there is no need to start from scratch when designing a Cyber Weapons School. The Air Force's Weapons School, the Navy's Top Gun, and the Army's Ranger School all have practices which, when properly employed, can create a ready-made, strong foundation on which to build a CWS. Its focus would be providing the experience and tools needed by cyber operators to become the leading experts in their home squadrons once they return. Because the CWS would not have the opportunity to train the entire career field due to operational and monetary concerns, as well as the pre-requisite experience required for admission, graduates would be expected to share their newfound knowledge. The Air Force Weapons School tells its students to, "make others like you, spreading the wealth of experience, leadership skills and knowledge."⁴ The Navy and the Army also promote this concept of "training the trainer," an idea that can be leveraged in the cyber community to

tors within their own squadrons, more people can be exposed to the various ideas and practices that will make the graduates the best in their field. This approach would encourage open-mindedness and promote a system of a bottom-up meritocracy of ideas in which the best become the most used rather than a having single school's syllabus dominating the field for better or worse.

Another dimension of the CWS modeled after its more kinetic counterparts would be its focus on practical applications of theory. While an undergraduate course may be more concerned with how to best use the weapons and materials given to the operator, a weapons school should be more concerned with how those weapons actually work. This is exemplified by how the Navy went about creating Top Gun: the initial instructors "wanted to teach the Top Gun crews how the [Sparrow] missile worked and therefore 'how they could successfully deploy it.'"⁵ In the classroom-based theory section of the CWS curriculum, emphasis should be placed on understanding how the various network warfare techniques and tools work. Using this fundamen-

tal understanding of how their tools operate, network warfare specialists would be well equipped to devise their own methods of operation and adapt quickly to a changing environment. Coupled with the expectation that graduates will help train, either formally or informally, members of their operational squadrons, it would also discourage a culture of expecting the weapons to work "like magic" within the cyber operations community.

The theory and engineering behind cyber operations are important to understand, but in order to fight best in cyberspace specialists must comprehend the connection between theory and actual operations. While the academic side should be modeled after the Air Force and Naval Weapons schools, the practical side should be based on the Army's Ranger school. This is because Top Gun was designed around, "training hops [that] were designed... to test the crew's ability to do all these [dog-fighting maneuvers] in a quick and efficient manner,"⁶ while the Ranger School is more concerned creating a long term, continuous training environment.⁷ Like an infantryman, a cyber operator conceivably could be engaged in continuous combat for extended periods. Ranger School simulates this by creating an overarching war game-type mission within which the students must function. The Air Force CWS should take a similar approach. By linking all the exercises together, a fictional cyber war can be created, allowing the instructors to create the most realistic "worst case" scenario for a cyber conflict. CWS graduates must experience and be

able to handle the accompanying stress in a manner similar to that of successful Ranger School students, something that the Air Force and Naval Weapons schools do not place emphasis on.

Officers do not dominate network warfare. The enlisted force also has an important part to play in operating systems. To best educate selected members of this force the CWS cannot be officer-exclusive as both aviation weapons schools are, and instead must accept enlisted students as well. This may pose problems for an Air Force-run Weapons School, which so far have not been expected to train enlisted personnel. To best deal with the challenge, the Army's methods of training their enlisted force in advanced courses should be used as a framework. For example, there is "no rank in Ranger School;" rather, everyone is given opportunities in leadership positions and are evaluated based on a common rubric for all students.⁸ This principle should also be extended to instructors, who must be selected for their outstanding proficiency and teaching capacity rather than the rank they happen to hold.

Established weapons schools also have an air of being reserved for the elite. The high dropout rates of Ranger School are well established at around 50 percent per class, including recycled students.⁹ Graduates of the Weapons School at Nellis Air Force Base have a special patch they wear and are categorized as "patch wearers." To be successful, the CWS must also

have an elite culture and reputation. Its graduates should be viewed as a brotherhood of the best cyber operators in the world. In large part this can be achieved through the standard methods currently in use at the established weapons schools. More specifically, the CWS must offer a comprehensive and very challenging course both, in theory and practical application. It should also have a strict selection process for potential students, as well as a system for evaluating CWS students and the authority to disenroll or recycle underperformers. CWS instructors should

never be known outside the classified community. Ideally, attending the Cyber Weapons School would be more than career advancing; it would also be a rite of passage.¹¹

Special Considerations

Cyberspace operations are unique in that they are far-and-away the fastest form of operations currently available. Richard Clark writes that, "Cyber war happens at the speed of light... the time between the launch of an attack and its effect is barely measurable, thus creating risks for crisis decision makers."¹² Other missions,

bound by the requirement to employ large pieces of physical equipment and Newtonian physics, are inherently slower than their cyber counterparts. Accordingly, the nature of cyber conflict requires that its operators be exceptionally quick thinking, intelligent, and independent in order to succeed in such a unique environment. These are all qualities generally assumed to be necessary for combat

officers, but in the cyber realm such qualities also must be possessed by enlisted members. A Cyber Weapons School should not only have both officer and enlisted students, but would also require a syllabus that is focused on developing fast, independent, and critically thinking warfighters. Students should not be provided set solutions or structured scenarios as is often the case with the established weapons schools at which, for example, a certain airframe can use the same maneuver on an enemy time and again and always



be military members, the very best operators in their community, and already have graduated from the Weapons School themselves.¹⁰

Graduates should be authorized an outward symbol of their achievement, most easily accomplished through the use of a patch they can wear on their operational uniform. Additionally, the instructors, and perhaps the students, should work to achieve a mythos of being legendary men and women, while realizing that many cyber-accomplishments will

claim victory because of the different limitations of each aircraft.¹³ In cyberspace, where every actor has the same capabilities and can execute any “maneuver” they wish, there cannot be prescribed solutions to specific problems. Instead, students must be taught to think quickly and creatively while operating effectively against unique threats.

Once a cyber operator has encountered a specific type of enemy action they should be able to effectively negate it through experience, as “exploits tend to depreciate rapidly after exposure; i.e., first time use.”¹⁴ This means that for an attack to be most effective it should be what is called a “zero-day” threat; that is, a program or exploit that has not yet been used. These threats, and their counters, can be thought of as analogous to the common cold. Consider: while a cold causes the same symptoms every time, ones’ body is still vulnerable to them even after decades of living because the virus changes how it is structured, and can then pass by the body’s defenses unnoticed and achieve its “mission.” Computer operations are generally intended to cause some sort of effect from an established list, but if an operator uses the exact same attack tactic repeatedly, it will be met with rapidly depreciating results, just as a biological virus that does not change its appearance would experience. As such, the school’s curriculum must be able to rapidly evolve to include current events, new threats and, most importantly, ensure that no two classes are provided the same scenarios. If a graduate was able to pass along a schedule of training events to a current student, the

CWS would have lost its ability to train outside-the-box, independent, quick thinkers.

A Snapshot of the proposed Cyber Weapons School

One basic question concerns the length of the course at the Cyber Weapons School. The US Army Ranger school takes two months to train its students.¹⁵ The Air Force Weapons School takes six.¹⁶ A dedicated CWS would be much more like Ranger school in this regard as unlike Air Force Weapons School students, CWS students would only be required to learn about cyber operations. Also, due to the quickly evolving nature of cyber operations, the school cannot be so long that its lessons become obsolete before graduation. The complicated math and engineering involved in advanced cyber activities is yet another factor, as it would take more than just a basic run-through to achieve the desired level of understanding. With these three factors considered, the CWS should ideally have a curriculum of roughly three months. While the initial cyber attack and defense course, known as Intermediate Network Warfare Training (INWT), is nine weeks, this is only long enough to prepare novice operators for their new job.¹⁷ For a critical in-depth understanding of the cyber mission, extra time will have to be allocated. A three-month-long syllabus should be sufficient to achieve such a level of understanding. Three months would also be long enough to achieve the desired social effects of camaraderie and to stress the students while still being short enough to hopefully, avoid becoming obsolete.

Because graduates of the CWS would be the absolute best network warfare specialists in the Air Force, they have to be well versed in every aspect of their career field. In all, there are three core specialties of cyberspace operations that must be covered in this school: computer network attack, defense, and exploitation.¹⁸ Network attack involves actively hampering enemy computer operations, exploitation is the collection of information, and defense is securing friendly networks against the previous two operations.¹⁹

While these competencies could be divided up equally by allocating one month of training to each, that would not be the best way to structure the material. Continuously teaching new concepts and applications, and expecting the students to master and employ them all in practice, would make for a more challenging course, facilitate smoother transitions between subjects, and offer a more realistic experience. By covering the theories behind each type of operation as well as practicing their application, the students would not only become adept at their particular mission, but would also better understand the actions of their opponents and thus be more likely to mitigate them effectively. A deep understanding of all the cyber missions would also enable graduates to become operators and leaders in any network warfare squadron, enabling the spread and diffusion of knowledge while still retaining maximum mission effectiveness.

In the INWT course students are taught a wide range of subjects intended to prepare them for their new job as network warfare specialists, including “policy,

doctrine, employment, executing organizations and missions, operational functions, and law and ethics.”²⁰ In comparison, the CWS would be one month longer and focus solely on how to best execute missions based on the assumption that students would already have an acceptable grasp of subjects such as cyber law and morality. Included in the CWS curriculum would be instruction on the theoretical and technical workings of cyber operations, much as current weapons schools teach how a particular missile functions so as to best employ or counter it. For CWS students, this would mean not just learning which operation to use when, but how each part of the weapon, or computer program, functions. By understanding their operational tools on an intimate level, the students would not be confined to using premade programs or standard missions. Instead, they would be able to tailor their actions to meet a specific challenge as well as more quickly conceive of ways to combine their mission’s tools for novel effects. The basics of which type of attack to use when and the knowledge of what to look for during a defensive or exploitation mission is taught at INWT and through job experience. The purpose of the theoretical instruction portion of the CWS would be to understand the inner workings of those capabilities, in which the operator would not have the time or the knowledge to learn independently.

The CWS program also would include practical exercises, which would constitute much of the curriculum. Students would be expected to leverage both their own experiences and classroom

instruction to devise and execute network warfare operations in realistic scenarios. Overarching conflict scenarios, similar to Red Flag or the Ranger School’s Aragon Liberation Front setting, would provide a backdrop against which to frame the training in a realistic way. There should be at least two teams for each scenario, perhaps with additional factions being added to further complicate the situation in later simulations. The instructors, because of their significant experience and skill, should take an active part in opposing the students in their assigned missions, but this should not be the only method of identifying teams. Student-on-student missions would expose exercise participants to even more variations of attack and defense, as would having instructors act as team leaders from time to time. These various types of student-instructor team combinations would expose the students to a greater number of different personalities and operational preferences, thereby giving them as much experience as is possible.

War-gaming events should also be relatively ill defined. Students should only receive a mission or desired end state and then be told to achieve it. Greater learning takes place when a problem is imposed without a known solution, as the students will not know what will be directed at them by the opposing team. Only by using quick, intelligent thought and action will they win. This, in turn, will encourage the students not only to understand the material but to think for themselves. Similar scenarios are set up at Red Flag for cyber operators, where the red and blue teams battle each other through net-

works.²¹ However, the CWS would go a step further than Red Flag. Students should not be told when or under what circumstances the scenario ends. That, coupled with twenty-four hour operations and multiple shifts, would present as realistic an environment as possible. Rather than just a regular school day, forcing the students to operate effectively in situations where they have high stress and no fixed end date would help further facilitate the types of learning and experience that CWS seeks to promote.

If CWS students are to learn effective cyber operations, they will require instructors who can understand and teach the material. These instructors should be the best operators the network attack and defense communities have to offer. They should have significant say in what particular lessons the syllabus includes, as they would be the best qualified to know what is important and what is not with respect to cyber operations. They would be best equipped to identify who is not performing up to standards or not putting forth the required effort in a way that standardized tests and objectives could not. Subsequently, CWS graduates, both officers and enlisted, would naturally become the primary pool for future instructors. Spending a tour as a teacher at the CWS would be very similar to a tour at other weapons schools in that such individuals would be identified as exceptional candidates for senior leadership positions and special duties.

Findings and Conclusions

There are many common features shared by weapons schools.

All of the existing schools expect their graduates to return to their units and teach others what they have learned. In this way, a larger audience can be reached without unduly taxing readiness or the weapons school's limited staff. Understanding the link between theoretical, classroom-based instruction and its implementation in realistic scenarios is also a common feature of all weapons schools. A major difference, though, is that while the Air Force school trains only officers, the CWS must include significant numbers of enlisted troops. The Army's Ranger School can provide direction on how to approach this problem as it holds that all rank is equal among Ranger candidates.

As noted above, cyber conflict differs from the other missions that currently are examined in existing weapons schools. In the case of cyber operations, there are never set, unchanging methods of operations. While a fighter pilot can learn how to defeat a particular airframe or missile with a high likelihood of success every time afterwards, network warfare specialists should expect to routinely find themselves confronted with attack techniques they have never seen before. Addressing this, the CWS should not focus on teaching prescribed solutions or set answers, but should instead seek to develop an intelligent, quick, and independent operator who can rapidly comprehend and perform effectively in unique scenarios.

The CWS's curriculum should focus on both the theory and practice of each of the three primary subsets of network warfare operations: attack, defense, and exploitation. Rather than examining these

missions separately, they should be studied in an integrated fashion that would provide both a tougher learning environment and more realistic scenarios. The classroom portion of the CWS would involve teaching the workings of the cyber environment as well as the tools used to complete missions that the operator may encounter. The main goal should be to give students the ability to create new capabilities based on their personal deep understanding. Most of the course should be spent in war gaming-type activities. Designed to be as realistic as possible, involving multiple teams, no checklists, an undisclosed end date, and twenty-four hour operations, these exercises should be designed to test the student's capability to effectively fight in a contested battle space against a sophisticated enemy.

Instructors should be drawn from the very best specialists in the network warfare community as they will be the ones who will develop the syllabus and run this premier cyber training unit. Rank should not be a factor when selecting faculty, just as it should not be a factor when selecting students. Once enrolled, the students should expect to be treated equally, regardless of specialty or rank, in order to encourage the best possible learning environment. Constant adjustment of exercise scenarios would also be necessary to reach the desired outcomes. If a set pattern of operations can be identified and shared among generations of students, then the CWS will lose its ability to surprise, which is crucial to the desired training outcomes. Additionally, a dynamic curriculum will enable the proposed CWS to stay abreast of advancing tech-

nologies and new threats, providing students with the most relevant education possible.

A three-month course at the CWS would be sufficient to achieve all of these objectives. Students are only expected to learn about the various capabilities within cyber operations. Accordingly, the CWS does not need to last six months like the Air Force Weapons School, which requires its students to learn and understand every type of mission performed by the Air Force. Three months is also long enough to significantly stress the students, testing their abilities even in the worst of situations, while remaining short enough to minimize the possibility of instructional content becoming obsolete before the students graduate. Finally, the CWS should be promoted as the premier Air Force school for cyber warfare training. In addition to all the factors described above, an identification symbol, most likely a cyber weapons patch, should be awarded to graduates as is currently the case at Nellis, which is the cyber-equivalent of the fighter weapons school patch. The "patch wearers" of the flying world are considered the best airmen, and the proposed Cyber Weapons School mentioned herein intends the same end result, to train and educate the best cyber-warriors.

¹ Cyber warfare, or computer network warfare, describes the missions carried out in the cyber domain. It is the use of computer networks and cyber assets to conduct attack, defense, and exploitation missions against an enemy's networks. The United States military describes it as the operation and use of the "global information grid;" the combined networks, software, services, and information connected to cyberspace. Joint Publication (JP), 1-02,

Department of Defense Dictionary of Military and Associated Terms, 12 April 2001 as amended through 31 July 2010, 143, http://www.dtic.mil/doctrine/new_pubs/jp1_02.pdf

2 The Air Force Weapons School is six months long, and includes students from every type of airframe as well as the intelligence, space, missile, services, and cyber communities; all of which are expected to learn each other's missions and operations. The primary focus of the school is kinetic operations, and support for the kinetic mission.

3 J.R. Wilson, "DMN Q&A: Robert Garland, Commandant, USAF Weapons School," Defense Media Network, <http://www.defensemedianetwork.com/stories/qa-with-col-robert-shark-garland-commandant-usaf-weapons-school/>

4 Ibid.

5 Robert K. Wilcox, *Scream of Eagles: The Creation of Top Gun – And the US Air Victory in Vietnam* (New York: John Wiley & Sons, Inc., 1990), 145.

6 Ibid, 146.

7 "Ranger Training Brigade: US Army Ranger School," Fort Benning, Georgia, <http://www.benning.army.mil/infantry/rtb/content/PDF/Ranger%20School%20web11.pdf>

8 Ibid.

9 Ibid.

10 Military members, as opposed to civilians or intelligence community people, are uniquely focused on the degradation and destruction of enemy assets, and are thus best suited for control of network warfare operations, and by extension the weapons school dedicated to it. Martin C. Libicki's book *Cyberdeterrence and Cyberwar*, page 156, provides a more detailed explanation of this position.

11 Wilcox, 173.

12 Richard A. Clarke and Robert K. Knake, *Cyber War: The Next Threat to National Security and What to Do About It* (New York: HarperCollins, 2010), 31.

13 Thomas Lang, interview by author, February 28, 2012.

14 Martin C. Libicki, *Cyberdeter-*

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17 Scott McNabb, "Initial cyber INWT class graduates schoolhouse," 24th Air Force, <http://www.24af.af.mil/news/story.asp?id=123251064>

18 Joint Publication (JP), 3-13, Information Operations, http://www.dtic.mil/doctrine/new_pubs/jp3_13.pdf

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20 Kinder Blache, "Intermediate Network Warfare Training Up and Running," 24th Air Force, <http://www.24af.af.mil/news/story.asp?id=123245134>

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SEIZING THE ULTIMATE HIGH GROUND

WEAPONIZING SPACE

JOSEPH SHIELDS

Historically, humanity's greatest advancements in technology have been fueled by conflict. As Everett Dolman, a widely published scholar who has written multiple works discussing the benefits of weaponizing space, points

It was competition rather than cooperation that propelled mankind into space.

out in his book, *Astropolitik*, it was competition rather than cooperation that "propelled mankind into space."¹ During the Cold War, the United States and the Union of Soviet Socialist Republics (USSR) were pushed to explore space as an expression of intense, competitive nationalism. Although the USSR was the first nation to reach space, the US was able to recover from that initial setback and take the lead in space innovation, becoming the first to land a man on the moon. In other areas of development, particularly military technology, closing the gap may not be possible, particularly if those developments are used to deny access to certain aspects of the battlespace.

Since the end of the Cold War, innovations in space technology have become relatively stagnant. Although US reliance on space assets, both military and civilian,

has become irreversible and the quantity and quality of the technology in use has increased, their capabilities and applications have not seen much variation.² It would seem that another conflict might be necessary to inspire further developments. Despite undeniable American dominance in current space capabilities, declarations by Chinese officials of intent to weaponize space, coupled with hesitance by American policy makers to make such a momentous decision, could potentially put the US at a disadvantage in the event of another arms race.³ While many insist that the weaponization of space is not likely to happen soon, the development of new military technologies has been a fact of human existence. Realistically speaking, there is little room for an increase in land-, air- and sea-based capabilities. Even the development of robotic warfare serves only to enhance current capabilities by overcoming human frailties. This leaves the domains of space and cyberspace. Although cyber-attacks are becoming more common, kinetic modes of combat will always be necessary. This begs the question: when the time comes to take the ultimate high ground, how should the US go about weaponizing space?

Although space has been militarized for decades, there is no

public knowledge of any space-based weapon platform currently in existence. This is due, in part, to the general taboo placed on the pursuit of such capabilities by the global community and the generally stated belief that space should be reserved only for peaceful uses, to include homeland security.⁴ However, many countries, such as the US, and Russia, and China, are keeping open the option of weaponizing space. As stated above, China has already declared its intent to weaponize space and the only widely signed treaty banning weapons in space refers to nuclear weapons.⁵ While the treaty was being negotiated in the early 1960s, attempts to ban all weapons in space were stalled by the USSR.⁶ More recently in 2008, prior to China's aforementioned statement of intent to place weapons in space, the *New York Times* reported that Russia and China presented a proposal to the United Nations (UN) attempting to revive a blanket ban on such weapons, a proposal which the US immediately rejected.⁷ Because the US itself refuses to abandon this line of research on space-based weapons, the subject must be explored. To begin analyzing how space could be exploited, one must first look at current capabilities.

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The US military performs many kinetic combat and defense roles. Not all of these would benefit in a particularly meaningful way from space-based platforms. Close air support for example, while technically possible, is not practical from a space platform. Accordingly the scope of this paper will be limited to ballistic missile defense (BMD), integrated air defense (IAD), and power projection. In this case, “power projection” refers to the mission statement of the US Air Force to provide global reach capability. Currently, this mission is limited by enemy air defense capabilities, particularly in contested air space. Integrated air defense refers to the systems in place designed to deny access to enemy air assets. Ballistic missile defense is, in the nuclear age, one of the most important military missions. It provides a measure of

tance in US security. Currently, US BMD capabilities are more advanced than those of any other country, but they are by no means infallible.⁸

According to the Missile Defense Agency’s website, the United States currently has four separate missile defense systems that can be employed at three different stages of an incoming ballistic missile’s trajectory. Each of the three stages, Ascent, Midcourse, and Terminal, are approached in the same way. Early in its flight, the incoming missile is picked up and tracked by an advanced network of land-, sea-, and space-based detection platforms. A short time into its flight, the trajectory of the missile can be predicted and an intercept course can be programmed into the actuators of the Ballistic Missile Defense System (BMDS).⁹

(SM-3), as well as short-range ballistic missiles in the terminal phase with the SM-2.¹⁰ On its website, the Arms Control Association classifies short-, medium- and intermediate-range missiles as those that can collectively strike anywhere up to 5,500 kilometers away.¹¹ The Aegis BMD is also capable of tracking the longer range intercontinental ballistic missiles (ICBM) and coordinating that information with other interceptor systems.¹²

Ground-based Midcourse Defense (GMD) is the primary defense system of the North American continent. Bases in Alaska and California are capable of launching a kinetic energy interceptor, called the Exo-atmospheric Kill Vehicle (EKV), on a three-stage rocket designed to impact ICBMs and some intermediate-range ballistic missiles outside the Earth’s atmosphere. The EKV is designed to destroy the target simply by striking it with adequate kinetic force.¹³

In the terminal defense segment, or final descent, of an incoming ballistic missile, the US has three BMD platforms. First, the Aegis BMD mentioned previously can attempt to intercept the missile once it reenters the atmosphere. The Terminal High Altitude Area Defense (THAAD) is a mobile BMD that can target the missile at higher altitudes both outside the atmosphere and upon reentry. Like the GMD, THAAD uses kinetic energy rather than a warhead to destroy the target. The third and final element is the PATRIOT Advanced Capability-3 (PAC-3). This platform is designed for both ballistic missile and air defense capabilities and is specifically intended to intercept missiles with a lower range, although it can



security and survivability that is not present in the mutually assured destruction (MAD) doctrine. The problem with MAD doctrine is that it is not an effective deterrent against non-state actors, and with increases in nuclear proliferation, BMD carries ever greater impor-

Currently, the first line of defense is the Aegis Ballistic Missile Defense System. The Aegis system employed by the Navy “defeats short- to intermediate-range, unitary and separating, midcourse-phase, ballistic missile threats with the Standard Missile-3

target ICBMs in their terminal or re-entry stage. The PAC-3 is employed by the US Army to compliment THAAD.¹⁴

The biggest issues with the US's current BMDS are time and gravity. Especially in the case of intermediate-range and ICBMs, these weapons are most vulnerable on their ascent when a large portion of their thrust is used to combat the effects of gravity. Once they begin their descent, ballistic missiles gain speed quickly as they close in on their target. Where this presents a problem is with long-range intercept methods. While the Aegis can be useful for shorter-range interceptions, the launch window against exo-atmospheric missiles is lamentably small before the more powerful ICBM will simply outrun the SM-3.

Long-range systems are limited by the same factors that make the ICBM vulnerable. There is a very limited window during which the GMD or THAAD must be launched in order to intercept the missile at the apex of its trajectory since both missiles must fight gravity on their way out of the atmosphere. If the first attempt to shoot down an incoming missile fails, then there will not be another opportunity to destroy the target before reentry into the atmosphere. After this point, the destruction of the target becomes not only more difficult but more risky. Gravity is now accelerating the missile while it slows the interceptors and destroying a ballistic missile in the atmosphere runs the risk of scattering whatever payload it might be carrying. This is especially hazardous in the case of biological and chemical weapons, where destruction of the target risks aerosolizing



Patriot or PAC 3 Launch

the payload wherever the wind takes it.

Although short- and medium-range ballistic missiles provide less time to be shot down, the geo-strategic location of the US means that any attack must come from an ICBM. If America's goal is to intercept these missiles before or during the exo-atmospheric stage, then preemptively placing a BMD network in orbit is the ideal solution. This way, the effort of fighting against gravity is already accomplished. When the ICBM is launched, the interceptors will already be waiting in orbit.

This space-based interceptor concept carries with it the potential for integration into the air defense system currently employed by the military. Current US air defense capabilities involve numerous early warning radar, ground-based missile defenses, and air-to-air weapons platforms. Ground- and air-based radar systems provide tracking capabilities of any detectable aircraft and relay this information to waiting air combat aircraft or surface-to-air missile sites.¹⁵ This IAD system works to deny aerial access to enemy forces. However, such systems are not unique to the US and those controlled by unfriendly nations are the greatest limiting factor on US

Air Force capabilities.

The “Vision” of the US Air Force is, “Global Vigilance, Reach, and Power.”¹⁶ As the space domain has typically fallen under Air Force jurisdiction, it seems only fitting that the future of space development grow in accordance with that vision. Currently, US aircraft have the collective ability to strike anywhere in the world in a matter of hours. Ballistic missiles reduce this time to thirty minutes or less. Quick and devastating strikes are the key to success for any air force and such tactics were used to great effect against industrial targets early in the history of air power, with new technology dramatically increasing their effectiveness. Formidable as these capabilities might be, such power projection is limited by the similar capabilities of America's adversaries. For the power projection capability of the US Air Force to surmount these challenges and achieve its vision, new technology must be introduced.

Each of the aforementioned three missions—BMD, IAD, and power projection—can be achieved by space-based weapon systems. The RAND Corporation outlines, in one of their many publications on policy and strategy, entitled *Space Weapons Earth Wars*, four types of space-based weapons. These include directed-energy, kinetic-energy vs. missiles, kinetic-energy vs. surface targets, and conventional space-based weapons. Directed energy weapons include electronic jamming, laser cutting torches, and a variety of similar weapons. None of the directed energy weapons currently employed on a practical scale are

powerful enough to accomplish the kinetic missions listed above and will not be referenced in this paper. The latter three depend on the transfer of potential energy to destroy the target. Kinetic weapons rely on velocity and mass to cause damage, while the conventional

Rods from God [are] kinetic energy weapons capable of delivering destruction on the scale of nuclear weapons due to their enormous mass.

weapons that RAND refers to typically use stored chemical energy (i.e., explosives) to achieve their effect.¹⁷ Kinetic energy weapons have the advantage of being mechanically simpler, as well as cheaper, than conventional weapons with the disadvantage that they must be traveling at great speeds to achieve the same destructive capability. This works well with space-based systems because the high altitude means the projectile has a high potential energy, which translates directly to kinetic energy as the Earth's gravity accelerates it towards a chosen target. The basic physics involved is set forth in the following equation:

Potential Energy = gravitational acceleration x projectile mass x altitude

As applied to BMD, when the weapon system is launched, it is imbued with kinetic energy by the boosters which transfers to potential energy as its altitude increases. After that, it is a relatively simple matter of converting the potential energy of the system back into kinetic energy using gravity and intercepting the ICBM's course at the proper moment with a GPS

guidance system. In essence, this system will work much like the "Hypervelocity Rod Bundles"¹⁸ mentioned in the 2003 "US Air Force Transformation Flight Plan," a theoretical weapon system that, in many circles, has come to be known as the "Rods from God."

There has been much discussion across the internet on physics websites and future weapons blogs about the concept of these "Rods from God," kinetic energy weapons capable of delivering destruction on the scale of nuclear weapons due to their enormous mass. A recurring argument against this idea is noted on the Popular Science website: "Launching heavy... rods into space will require substantially cheaper rocket technology than we have today."¹⁹

While this is a legitimate concern for the powerful weapon system mentioned by the Air Force, the force of a nuclear weapon is far greater than the kinetic energy required to destroy any legal targets in a conflict, conventional or non-conventional. Although the cost of a space-based weapon system would be great, it would not be so prohibitively high as to prevent its implementation due to the far smaller weight of any useable weapon.²⁰

The greatest issue with this system is the problem of atmospheric reentry. The smallest and cheapest system would destroy ballistic missiles outside of the atmosphere where reentry would not be an issue. This limits the window of opportunity to the brief time when the target is above sixty kilometers.²¹

In order to engage below that altitude, larger projectiles with

atmospheric reentry capabilities would need to be built, greatly increasing the cost of the system. A reentry vehicle is required for such weapons, kinetic or conventional, intended for use against ground or aerial targets. The limitations of such kinetic weapons include the fact that, in order to maintain velocity, their maneuverability and target window is severely limited. In addition, because they derive their power from the pull of gravity, reentry angles must be steep, giving the weapon system a very narrow scope of targets at any given time. Because of this, a useful system would require deployment of a larger number of satellites to be in position to strike targets anywhere around the globe in a reasonable amount of time. According to RAND's study, six platforms in high orbit would only provide targeting opportunities every two to three hours.²²

These problems are addressed by RAND's fourth weapon type, conventional space-based weapons. Because these weapons rely on their explosive payload to do damage, they are less reliant on the pull of gravity and more maneuverable. This seems to suggest that, while kinetic weapons are limited to relatively slow-moving or stationary targets such as buildings or ships, these weapons could theoretically engage a wider range of targets, to include aircraft and missiles. This also results in a greater targeting window. The same number of space-based platforms requiring hours for kinetic systems to be in place could provide targeting opportunities within minutes using maneuverable weapons.²³

With any given weapon and type of mission, there are a few

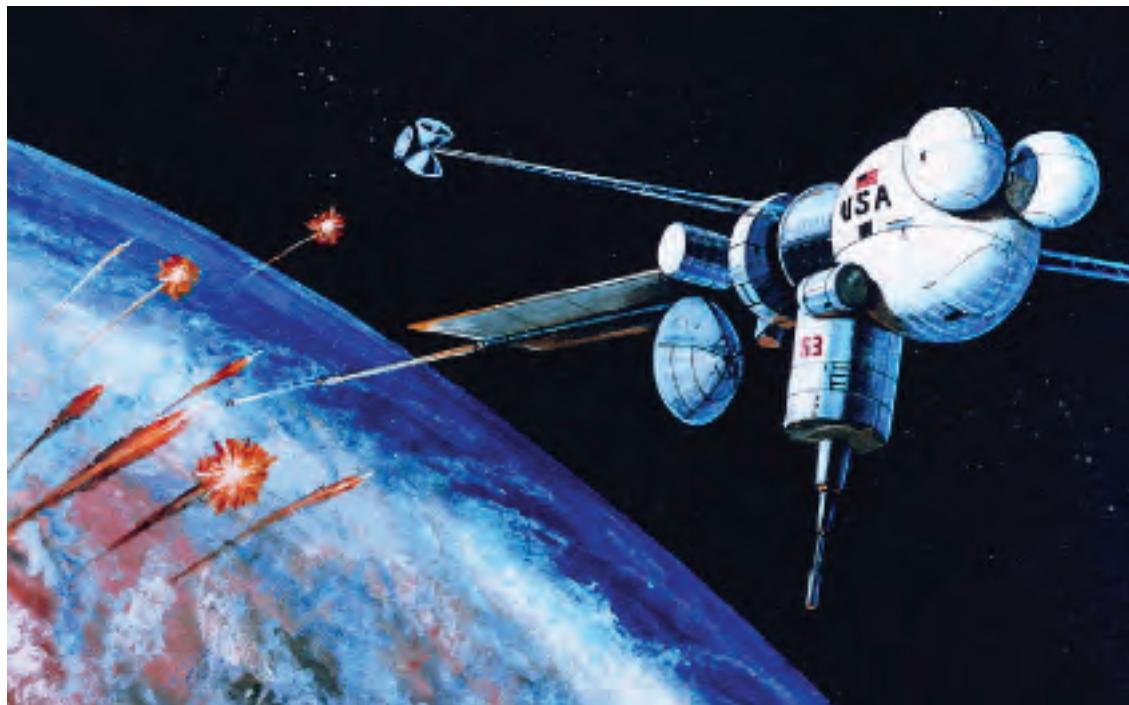
security concerns that must be addressed when determining how to deploy these capabilities. The first step in establishing an undoubtedly unpopular space-based arsenal must be to ensure its security. Employment of space-based weapons would undermine long-standing treaties and unwritten agreements not to pursue an arms race or place ballistic missile defenses in space. Aside from the political backlash, certain countries will likely view this as an attempt to destabilize the MAD doctrine that has thus far prevented nuclear war. Deterring the threat of a first strike attempt, then, should be the first step in establishing space superiority. This must be done quickly if it is to be effective because once the US plan becomes public knowledge, any military retaliation would have to engage before the system is in place to have a guaranteed effect.

The next concern is the demonstrated ability of other countries' anti-satellite (ASAT) weapons. Fortunately, such weapons operate on similar principles to ICBMs and must exit the atmosphere while operating against gravity. Once established, space BMD assets will be capable of destroying those threats before they have the chance to knock out a satellite. Non-BMD platforms, such as those designed for ground strike missions, must be within a certain proximity of such

a system to ensure survivability.

The third concern is the development of future technology by competing nations. Even if the US

such a system is the crucial step when any weaknesses in the net will be found and exploited and, should it fail, another opportunity will be less likely to present itself.



manages to establish its weapons in space before opposing nations can counter with their own developments, there is no doubt that the power gap created by such a capability will result in attempts to counter US space superiority. In other words, a space arms race is likely to ensue. In order to maintain the lead, the US must anticipate future adaptations to the new way of fighting. These potential adaptations could be combated through policy change, a shift in tactical focus, or any other means depending on the perceived threat, but the military must be flexible.

With these challenges in mind, it is imperative that the weaponization of space must start with an effective BMD satellite constellation. Decisions about this system cannot be influenced by anything other than effectiveness. The initial deployment of

While building a system that uses RAND's kinetic exo-atmospheric weapons to protect the US might seem desirable, it must be considered that a nuclear-capable nation with far less reliance on space assets than the US might detonate a nuclear device upon exiting the atmosphere, resulting in an electromagnetic shockwave that would knock out the new system along with every other satellite in the area. The kinetic destruction of a single Chinese satellite in 2007 in Low Earth Orbit (LEO) resulted in about 15,000 pieces of debris that are expected to threaten space assets for more than twenty years into the future.²⁴ The collateral damage resulting from a nuclear explosion in LEO would be far worse. As such, the initial BMD system must be capable of destroying targets before they exit the atmosphere.

In terms of the third concern listed above, there are many possible situations that may arise, not all of which will be covered. This paper will discuss briefly some of the opposing strategies

...given historical trends of realist politics along with technological and military dynamics, it is only a matter of time before weapons find their way into space.

that could prove problematic for the continued effectiveness of a space-based arsenal, although solutions to those problems are properly the subject for another paper. Assuming that the established BMD system is capable of defending itself from ground-based missiles, countries may look for other means to circumvent the defenses. Launching new “Trojan” satellites carrying ASAT weapons or self-destructive charges disguised as peaceful purpose satellites, or even redirecting existing satellites to collide with the weapon systems, are the biggest threats after the neutralization of ballistic missiles. The US will have to establish a policy regarding the launch of foreign satellites to prevent this, and/or establish countermeasures to prevent intentional collisions. Additionally, the potential to target surface capabilities may result, in the longer term, a shift in war-fighting strategies from surface to sub-surface warfare. Once initial attempts to counter a US space arsenal are exhausted, one could expect that there will be a shift toward short- to medium-range submarine-based nuclear missiles by US competitors/enemies, resulting in unknown launch points and

shorter flight times to complicate targeting by the space-based systems. Such counters might be viewed as an effort to correct the perceived disruption of the Cold War-era MAD doctrine.

There are many political concerns that are beyond the scope of this paper. However, given historical trends of realist politics along with technological and military dynamics, it is only a matter of time before weapons find their way into space, as Dolman advocates. The key for success in the future is to be the first nation to take that step. Although there will be inevitable political consequences, the US cannot allow itself to be placed at a major strategic disadvantage by its recent technological stagnation and an excessive concern with global opinion not shared by its rivals.²⁵

Although political backlash will be unavoidable, the deployment of US space-based weapons must be executed completely, resolutely, and swiftly. Though national security may temporarily be at greater risk during the deployment phase, once space-based defenses are in place, they will provide security for the global commons, much like the US Navy has provided on the high seas for decades, ensuring the safe movement of sea-based commerce, benefitting all, not just the US. A space-based system must first be defensively focused to demonstrate a US concern for global security and others must be assured that there are no aggressive intentions; control of global orbits will ensure that satellite commerce is safe from other would-be aggressors. Others aggressively-intended systems would be prevented from reaching orbit. Once the system

is in place, to include the establishment of an international body governing orbits and approving space-bound payloads, US national security policy and strategic focus will still need to accommodate the inevitable accompanying shifts in strategic warfare capabilities. In a world ruled by self-interest, the party that always plays nice will lose to the party that acts in its own self-interest. But in space, like the sea, US self-interest can serve mankind.

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23 Ibid.

24 Shirley Kan, "China's Anti-Satellite Weapon Test," CRS Report for Congress, 23 April, 2007, <http://www.fas.org/sgp/crs/row/RS22652.pdf>

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Gyre Falcon,
Alias - "The Bird"

AN AIRPLANE FOR ALL SEASONS

AN EVALUATION OF THE MOST APPROPRIATE AIRCRAFT FOR THE LIGHT ATTACK MISSION

BRANDON SCHOENFELDT

In October 1994, Air Force Special Operations Command (AFSOC) fielded the 6th Special Operations Squadron (6 SOS), the first-ever USAF squadron dedicated to the foreign internal defense (FID) and coalition support mission areas.¹ The creation of this specialized unit demonstrated the increased need for an advisory group capable of training and equipping foreign militaries to enable them to defend their countries through the use of airpower. Throughout much of airpower history, supporting and teaching foreign militaries the most effective tactics, techniques, and procedures (TTPs) for employing their aircraft has been viewed as a mission with significant military and political implications.

The underlying problem with training foreign militaries is that in order to have experts on foreign aircraft, the United States also must own and operate these aircraft. Special operations consist of the ability to adapt and overcome in any area of warfare; however, the potential of the US Air Force “to adapt” has been impaired by a failure to develop a light attack aircraft (LAS) with significant FID capabilities. The absence of such an aircraft is impairing the FID mission. As recently stated by Maj Gen Richard Comer, “The

Air Force stands at a fork in the road, deciding how much of its resources it should devote to the current war and its irregular nature [i.e., Afghanistan], and how much to the threats of a peer competitor challenging its dominance of air and space.”² The decision to select an aircraft to help train the Afghan



Embraer A-29 Super Tucano

Army Air Corps has been made, but because of subsequent controversy over the selection process, acquisition of a LAS aircraft has been delayed. This troubling situation then leads to the question: “In an era of increasing budget cuts, has the United States Air Force selected the most appropriate aircraft for the foreign internal defense and light attack mission?”

Background and Significance of the Problem

The Air Force has had a long standing engagement with the foreign internal defense mission. “With roots in special air warfare

dating back to the Vietnam War and even as far back as the Second World War, the 6th SOS was created to advise, train, and assist foreign aviation forces in the application of airpower in internal defense and development.”³ A principal challenge involves not so much the importance of foreign internal defense, but rather acquisition of the most appropriate aircraft to conduct that mission. Third world countries cannot operate the United States’ F-16s nor can they handle the maintenance and repairs of such an aircraft. On the other hand, the US Air Force seems institutionally predisposed to fast jets, American-made products, and sophisticated aircraft generally. “Since its inception...the 6th SOS has been plagued by a host of difficulties in fulfilling the vision of its creators, the most salient of which stem from the question of whether the squadron should have aircraft appropriate to its third world mission.”⁴ This problem has become increasingly urgent and involves decisions about which aircraft would be the most effective, and whether the FID mission even requires a light attack aircraft. However, the 6th SOS and the Air Force currently do not maintain

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the most appropriate aircraft for the FID mission in Afghanistan and other countries. Lt. Col Wray Johnson notes, “Aircraft remain critical to the original vision of what has become the 6th SOS....”⁵

This assertion remains true not only for the 6th SOS but for the Air Force as a whole during the current era of contingency operations and the longer-term threat of involvement in such operations in the future.⁶

Several definitions are crucial to understanding the capabilities of LAS/FID aircraft as well as comprehending the needs of the FID mission:

Foreign Internal Defense (FID)-- According to Joint Publication 3-05, foreign internal defense involves, “participation by civilian and military agencies of a government in any of the action programs taken by another government or other designated organization to free and protect its society from subversion, lawlessness, and insurgency.”⁷

Short Take-off and Landing (STOL)-- Joint Publication 1-02 defines Short Takeoff and Landing as, “the ability of an aircraft to clear a 50-foot (15 meters) obstacle within 1,500 feet (450 meters) of commencing takeoff or in landing, to stop within 1,500 feet (450 meters) after passing over a 50-foot (15 meters) obstacle.”⁸

Intelligence, Surveillance, and Reconnaissance visualization (ISR visualization)-- According to the Joint Publication 1-02, intelligence, surveillance, and reconnaissance visualization consists of, “The capability to graphically display the current and future locations of intelligence, surveil-

lance, and reconnaissance sensors, their projected platform tracks, vulnerability to threat capabilities and meteorological and oceanographic phenomena, fields of

A-29 Super Tucano light turboprop training and attack aircraft. This aircraft is used throughout the world for counterinsurgency operations as well as for flight

This study argues that successful accomplishment of the USAF Foreign Internal Defense mission in Afghanistan requires the Embraer A-29 because of its capabilities and demonstrated success in comparison to the less capable Hawker Beechcraft AT-6.

regard, tasked collection targets, and products to provide a basis for dynamic re-tasking and time-sensitive decision making.”⁹

This study assumes that new special purpose aircraft are required for specific missions in FID. Those missions include drug interdiction, intelligence, surveillance, and reconnaissance missions, light attack, and most importantly flight training for the Afghan Army Air Corps. This study argues that successful accomplishment of the USAF Foreign Internal Defense mission in Afghanistan requires the Embraer A-29 because of its capabilities and demonstrated success in comparison to the less capable Hawker Beechcraft AT-6. Drawing on this analysis, the study will evaluate why the A-29 is needed for employment in current and near-term future FID operations. On the basis of anticipated operational requirements, data will be presented that clearly make evident the superiority of the A-29 over the AT-6.

In December 2011, the US Air Force announced the completion of contract for the Light Support Aircraft (LAS). The contract was awarded to the Sierra Nevada Corporation and its Brazilian partner, Embraer, for production of twenty

training. The Air Force’s plan was to use this aircraft in Afghanistan as a platform to train the nation’s army air corps. The competition for the contract was between the AT-6, produced by Hawker Beechcraft Corporation based in Wichita, Kansas, and the A-29 Super Tucano. Hawker Beechcraft was disqualified from the competition causing resentment toward the only other contender for the bid. Subsequently, “Hawker Beechcraft Corporation...filed a lawsuit against the US government after the company’s AT-6 light attack turboprop...was ejected from the competition for submitting a ‘technically unacceptable’ bid.”¹⁰ In late February 2012, the Air Force canceled the contract with Sierra Nevada Corporation pending investigation of the award decision. Air Force Secretary Michael Donley said in a statement, “While we pursue perfection, we sometimes fall short, and when we do we will take corrective action... Since the acquisition is still in litigation, I can only say that the Air Force Senior Acquisition Executive, David Van Buren, is not satisfied with the quality of the documentation supporting the award decision.”¹¹ Although the contract has been cancelled the question still remains: Is the A-29 the best

choice for the Light Support Aircraft in the context of the foreign internal defense mission?

According to Buck Sexton of The Blaze,¹² “In conflict zones around the world, the need for nimble, low-maintenance reconnaissance and light attack capability far outstrips the need for the most advanced 5th generation airframes. The US needs an aerial platform it can give to and train allies on as part of partner building efforts in Afghanistan and other conflict nations.”¹³ The Air Force must make a decision that will best support the vitally important FID mission. A light support aircraft has been sought after for the war in Afghanistan since 2006. Having an aircraft that is simple and effective in a counterinsurgency environment is key to success. Hawker Beechcraft agrees with that requirement but questions whether that should be a consideration in the decision. Jim Moore, an author for the Aircraft Owners and Pilots Association magazine said, “[Hawker] agreed that the overall mission in Afghanistan merits careful consideration, but insisted the Air Force decision was not related to recent developments in the war-torn country. [Hawker] agreed that a “major reassessment” of Afghanistan strategy could make the contract moot, but the procurement process needs to be reformed.”¹⁴ Given the recent announcement of the US drawdown in Afghanistan, the need for an effective light air support aircraft is crucial and the best, most appropriate aircraft needs to be identified and acquired without undue delay. According to Defense Tech,

The LAS mission requires a non-developmental solution that provides the versatility, engagement, and persistence that the war fighter needs in a counterinsurgency environment, at a significantly lower cost than fighter jets. That aircraft must offer intelligence, surveillance, and reconnaissance (ISR) capabilities; deliver a wide variety of munitions configurations, including precision guided munitions; and operate in extremely rugged terrain and austere conditions.¹⁵

The mission is incredibly important not only for the successful conclusion of the war in Afghanistan, but also for future counterinsurgency operation and for the success of the continuing FID mission. As budget worries continue to grow, the contract for a LAS aircraft may be scraped completely. “There’s no way to put a happy face on this,” Chief of the Staff General Norton

that has not been tested in combat nor has it had the opportunity to prove its abilities in austere conditions. In contrast, the Super T has been widely used throughout Latin America for many counterinsurgency operations in which it has demonstrated the effectiveness of its simple design and its flexibility. According to an article in the *Wall Street Journal*,

The A-29 Super Tucano was built specifically for counterinsurgency missions and is currently used by six air forces...It has proven extremely capable for LAS missions and is credited with helping the Colombian government defeat the FARC and other governments’ counter illegal activities. The more than 150 units now in operation around the world have logged over 130,000 flight hours, including more than 18,000 combat hours without any combat loss.¹⁷



USAF T-6 Texan II Trainer

Schwartz said, noting that funding for up to twenty aircraft expires in 2013. Schwartz said the aircraft is vital to Afghanistan’s military. “We will work with all dispatch.”¹⁶

An objective evaluation of the Super Tucano and AT-6 will help to resolve the choice the Air Force must make. The Super Tucano, or Super T, currently is the only combat-proven light attack aircraft in the world. This does not mean the AT-6 lacks the capabilities of a good light attack platform, but it is still a conceptual design

This operational record points out the capabilities of the Super T, which possesses many other added advantages over an unproven aircraft. For example, the Super T is the only aircraft with the proven ability to carry and deliver precision guided munitions while operating in extremely rugged terrain. This record of accomplishment is worth noting because the ideal light attack aircraft must be able to provide many different operational capabilities at a relatively low cost.

In terms of comparative dimensions, the Super T is a significantly larger aircraft than the AT-6 and sits higher off the ground in order to provide stability on unimproved runways. It combines a heavier platform with more rugged landing gear that is more suitable for the many unimproved runways in Afghanistan and elsewhere in the third world. The Super T’s larger landing gear and broader

stance produces a greater distance between the wheels making them more suitable for rough landings. These factors contribute to more stable handling, especially for newer pilots who tend to make harder landings.

Another key difference between the two aircraft is their respective weapon systems and payload. The Super T has two internally mounted guns that do not take

The A-29 has been tested and proven. It is not a concept design that may or may not work. Time is running out to begin production of the aircraft and to ensure that US Air Force pilots are fully qualified to fly it under demanding operating conditions. For all of the foregoing reasons, the Super Tucano represents the best option for a timely decision and is reflected in a letter from Representative Allen B. West to the Secretary of the Air

The A-29 Super Tucano is the only aircraft in LAS competition that has a combat record. It has been in service for seven years and been flown in actual combat by five nations, with no combat losses.

up any vital hard points allowing them to be used for other weapons. In contrast, “The AT-6 carries no weapons in its native configuration and therefore must give up a vital ‘hard point’ under each wing for a gun pod exacting a penalty in both payload and performance.”¹⁸ The Tucano can also accommodate 133 fully qualified NATO ordnance and operational weapons load configurations.

A significant additional mission for the LAS aircraft will be conducting ISR for sustained time-frames. The Super Tucano has a fully integrated EO/IR imaging system positioned under the nose for maximum effect, to include space and visibility. Sierra Nevada Corporation points out that, “Due to a lack of space and balance, the AT-6 places its thermal imaging system under the cockpit, which leads to degraded effectiveness whenever the plane drops a wing to turn.”¹⁹ In contrast, the Tucano cockpit contains state of the art displays and is configured for ease of handling.

Force,

The safety of our men and women on the ground in Afghanistan and the security of our nation depend upon an Afghan military that is capable of defending against the Taliban and other extremist organizations. A light air support capability is essential to this objective.... The road to providing US commanders in Afghanistan with the light air support capability they urgently requested has been paved with numerous unnecessary delays. These delays are endangering our security, wasting taxpayer dollars, and prevent us from putting Americans to work building these aircraft. I hope that the Air Force has a plan for minimizing further delay and mitigating the adverse affects of this latest action.²⁰

As for the AT-6, it is a great trainer aircraft and as has been used very effectively for that purpose for many years. The problem involves taking an aircraft purposely built for training and attempting to turn it into a combat-capable aircraft. Of course, the AT-6 does have a few unique advantages. Every US Air Force and Navy pilot in the grade of senior lieutenant or below has recent experience with

the systems employed in the T-6 trainer. Defense Analyst Daniel Goure states, “Another reason that the AT-6 makes sense is because it facilitates an easy and natural relationship with the US Air Force, given its experience with the T-6 trainer and partner countries. US pilots and maintainers would not have to learn how to fly a different aircraft in order to train foreign air force personnel.”²¹ This experience would require less training for USAF instructors assigned to train pilots of other nations. Secondly, understanding of maintenance issues, parts, and familiarity with the aircraft already exist because the T-6 is an integral part of pilot training for both the Air Force and the Navy. Nonetheless, that does not mean it is ready for less sophisticated nations such as Afghanistan. When dealing with less technically competent countries and with different languages, the overall simplicity of an aircraft must play a vital role in the procurement decision. The availability of an aircraft that already is in use worldwide is important to note. Although the T-6 is currently fielded in Iraq, Iraq is the only country outside of the US to operate this aircraft. In comparison,

The A-29 Super Tucano is the only aircraft in LAS competition that has a combat record. It has been in service for seven years and been flown in actual combat by five nations, with no combat losses. Embraer – as well as this specific aircraft, the A-29 Super Tucano – has a strong military track record. Embraer has supplied more than 1,300 aircraft to armed forces in 31 nations. The A-29 Super Tucano is operational and combat-proven and flying with nations similar to those targeted for the LAS mission. More than 173 A-29 Super Ts are in use or on-order by armed forces around the

world. It has more than 100,000 flight hours and 16,000 combat hours, with no combat losses, and it is certified for more than 130 weapon configurations. The Super Tucano also is the plane that was tested and requested by the US Navy for Imminent Fury.²²

Currently the focus is on a 2011 lawsuit filed by Hawker Beechcraft for being eliminated from the competition and the recent cancellation of the project while Hawker Beechcraft's objections are evaluated. But the true focus should be on making sure whatever aircraft is selected represents the best choice to support the needs of the military. Secondary questions such as how many more jobs would be produced in America should not be an issue while the nation is still at war and requires the most capable LAS aircraft to help complete the mission. The focus for many is on the fact that the A-29 is a Brazilian aircraft. However, Embraer has teamed up with the US Sierra Nevada Corporation to compete for the LAS bid and ultimately will bring additional jobs and money to the US through subcontracts with American companies. Sierra Nevada Corporation states, "The A-29 Super Tucano will be built in Jacksonville, FL, by American workers with parts from American companies. Training on the aircraft will be provided in Clovis, NM. More than 60 US suppliers in 19 states will supply parts or services for this contract. At least 1,200 US jobs will be supported through this contract."²³

The mission in Afghanistan includes a variety of coalition partners. The availability of an aircraft that is familiar to some partners increases the likelihood of effectively training the new Afghan

pilots.²⁴ As one experienced fighter pilot states, "The A-29 Super T has the same Hands-on-Throttle-and-Stick (HOTAS) and cockpit configuration as a modern fourth generation fighter aircraft. Yet, it is highly efficient to operate and easy to fly. It has unrivaled endurance, giving the war fighter the persistent ISR, kinetic, or training support."²⁵ The Super T is perfect for the low altitude missions expected of it. "Crew survivability is ensured through armor protection and state-of-the-art provisions such as a Missile Approach Warning System and Radar Warning Receiver, alongside chaff and flares dispensers."²⁶ Giving further credence to its potential survivability is the Super T's successful track record in its current training environment. "The Super Tucano's airframe was designed for single- and twin-seater versions and can withstand +7G/-3.5G loads. The aircraft's structure is corrosion-protected and the side-hinged canopy has a windshield capable of withstanding a bird strike at 270 kts."²⁷

The terrain of Afghanistan is rugged and unforgiving at times for inexperienced pilots. Flying an aircraft that offers added safety and protection in this stern environment is an important consideration. The need for an aircraft to support the FID and light attack mission is a pressing one for commanders in Afghanistan. An objective evaluation clearly suggests the Super Tucano is the best choice for current and future LAS missions

around the world.

Although both aircraft, the Hawker Beechcraft AT-6 and Embraer A-29 Super Tucano, have their own unique strengths, the A-29 Super Tucano is the best choice for the situation we face in Afghanistan. Moreover, this aircraft will also provide a superb platform for future FID missions worldwide, especially those conducted in South America. The LAS contract requires a low cost solu-



Indonesian Air Force Tuscanos

tion for an aircraft that offers the engagement and persistence a war fighter needs in a counter insurgency environment. Clearly, the Super T best meets these needs. "The Super Tucano meets all the requirements of the LAS mission and then some. It provides the highly advanced avionics and communications that pilots need. It makes no compromises when it comes to crew survivability, aircraft controllability or combat effectiveness."²⁸ The Super Tucano is ready for employment in the harshest conditions and is the best choice to meet the Air Force's needs.

1 Wray Johnson, "Ends Versus Means: The 6th Special Operations Squadron and the Icarus Syndrome," *Air and Space Power Journal*, <http://www.airpower.au.af.mil/airchronicles/cc/WJohnson.html>

2 Richard Comer, "An Irregular Challenge," *Armed Forces Journal*, <http://www.armedforcesjournal.com/2008/02/3290589>

3 Wray Johnson, "Whither Aviation Foreign Internal Defense," *Airpower Journal* 11, no. 1 (Spring 1997): 66-85, <http://www.airpower.maxwell.af.mil/airchronicles/apj/apj97/spr97/johnson.html>

4 Ibid.

5 Ibid.

6 Limitations: The limitations of this study pertain to the recent selection of the light attack aircraft for the FID mission and the needs for this aircraft. This study will not address the political dimensions of foreign aircraft versus American-made aircraft. Training and maintenance are critical to the FID mission, and the capabilities of the two aircraft being compared will address the issues at hand. This study will not address any other aircraft than the A-29 and the AT-6. These aircraft are the primary contenders for the FID and Light Attack Mission (LAM) and therefore will be the primary focus of this study.

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8 Ibid., 424.

9 Ibid., 233.

10 Dave Majumdar, "USAF Halts Work on Attack Planes for Afghans," *Defense News*, January 9, 2012: 26.

11 Andrea Shalal-Esa, Air Force scraps deal with Embraer, Sierra Nevada, February 28, 2012, <http://www.reuters.com/article/2012/02/29/us-embraer-snc-aircraft-idUSTRE81R1W920120229>

12 *The Blaze* is a magazine that focuses on topics ranging from culture to politics. The Authors have an interest in new dynamics that are important today.

13 Buck Sexton, *The Blaze*, January 3, 2012, <http://www.theblaze.com/stories/check-out-the-super-tucano-counterinsurgency-fighter-plane-in-action/>

14 Jim Moore, Air Force halts controversial contract: Afghan light air support deal may be dead, analysts say, February 28, 2012. <http://www.aopa.org/aircraft/articles/2012/120228air-force-halts-controversial-contract.html>

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17 PR Newswire, "A-29 Super Tucano Wins Air Force Bid for Light Air Support Mission," *Wall Street Journal*, February 2012: 1.

18 Sierra Nevada Corporation, Built for the Mission, 2009. <http://www.builtforthemission.com/a-29-vs-at-6.php>

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22 Sierra Nevada Corporation, Built for the Mission, 2009. <http://www.builtforthemission.com/a-29-vs-at-6.php>

23 Ibid.

24 The A-29 Super Tuscano is flown in some African and Latin American countries, including US allies Brazil and Columbia.

25 Ibid.

26 Sexton.

27 Ibid.

28 Sierra Nevada Corporation.



Where the acquisition decisions are made

PERSONNEL RECOVERY

THE CV-22 OSPREY EXPANSION PACK

VINCENT T. JOVENE III

Time has a funny way of changing things. In the words of Italian Air Marshall Giulio Douhet, an aggressive advocate for airpower in the early twentieth century, “Victory smiles upon those who anticipate the changes in the character of war, not upon those who wait to adapt themselves after the changes occur.”¹ What works well in today’s fights will not necessarily work well in tomorrow’s. Most of the armed conflicts of the twentieth century were fought conventionally, and the US dominated the battle-space. As a result, adversaries quickly realized that they could fight more effectively and cause significantly more damage to the US by conducting irregular warfare. Operations that were once relatively simple are now complex. These changes have greatly affected missions and operations of US combat search and rescue forces. Fighter pilots are in less danger of being shot down behind enemy lines; instead, terrorists are snatching any Americans they can and hiding them in insurgent safe houses. The US is currently, and will likely continue to be, engaged in multiple irregular conflicts around the world. The myriad of locations and types of engagements present several hurdles to Combat Search and Rescue (CSAR) forces’ capabilities. These diverse challenges prompt the question: does the US Air Force have the most effec-

tive aircraft inventory to perform personnel recovery missions? The short answer is that given the wide range of conflicts the US confronts,

defined as, “the sum of military, diplomatic, and civil efforts to prepare for and execute the recovery and reintegration of isolated

The US is renowned for taking care of its own and refuses to allow the enemy any opportunity to take advantage of Americans. Therefore, personnel recovery is extremely important to the military’s top leaders.

the Air Force does not have the most effective inventory and must acquire more versatile aircraft to most effectively perform personnel recovery.

Why an Inventory Upgrade?

Today’s Air Force relies almost solely on HH-60 Pave Hawks and HC-130 Kings for the bulk of personnel recovery missions. While HH-60s and HC-130s are valuable rescue assets, the HH-60 has, “acute performance limitations in areas such as speed, range, carrying capacity, and reliability that are evident in harsh environments such as Afghanistan and in Iraq.”² These weaknesses are a serious disadvantage in many of today’s conflicts. The Air Force needs a more robust, versatile selection of faster aircraft that can operate over longer distances, at higher altitudes, and in tighter spaces.

Personnel recovery and CSAR are not the same thing and a distinction should be made between the two. Personnel recovery is

personnel.”³ Isolated personnel are, “those US military, DOD civilians, and DOD contractor personnel who are separated...from their unit while participating in a US-sponsored military activity or mission and who are...in a situation where they must survive, evade, resist, or escape.”⁴ Personnel recovery essentially applies to the rescue of anyone that is separated from their unit. CSAR is a tactic of personnel recovery; it is an active location and recovery process used in high-threat situations to return isolated personnel to friendly control. Not every case of isolated personnel will require a CSAR mission or CSAR assets; oftentimes a single, small aircraft will suffice.

The US military’s most valuable asset is its people. In today’s irregular conflicts, terrorists know that if they can capture Americans, they can exploit their prisoners in ways

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that can cause strategic damage to the US while furthering their own objectives. The US is renowned for taking care of its own and refuses to allow the enemy any opportunity to take advantage of Americans. Therefore, personnel recovery is extremely important to the military's top leaders. As Joint Publication 3-50 states, "preserving the lives of those participating in a US-sponsored activity or mission is one of the highest priorities of the Department of Defense."⁵

Air Force holds the responsibility for providing a dedicated personnel-recovery force.

Major Chad Sterr, an Air Force combat rescue officer, declares that while rescue forces are appreciated at the tactical level for bringing everyone home, "airpower advocates often fail to understand [the rescue mission's] inherent strategic value as part of the broader personnel recovery...function." Sterr says that the Air Force has, "developed the rescue force into the service's [personnel recovery] experts..."

of the negative implications surrounding isolated personnel, the Air Force needs the most effective aircraft platforms for personnel recovery for the widest range of situations.

THE OPTIONS

Osprey versus Pave Hawk

The uncertainty involved in irregular warfare contributes a significant amount of added confusion to the fog and friction of war. In the unpredictable combat environment frequently encountered today, speed is of vital importance. Denying the enemy an opportunity to exploit an isolated American, preserving the lives of wounded troops, and building rapport with civilians by aiding their injured are all missions where the capability to rapidly engage and disengage can mitigate that confusion. When things go wrong in the combat environment, rapid arrival of a rescue force can make the difference between success and failure. While the Air Force currently relies on the HH-60 Pave Hawk to perform the personnel recovery mission, it also has in its inventory the CV-22 Osprey, presently employed for special operations missions. If the Air Force expands its personnel recovery inventory to include the CV-22, it arguably could more effectively carry out personnel recovery missions. Major John Groves, an Air Force Special Operations pilot, says that the CV-22's, "unique capabilities of the aircraft, particularly range and speed, qualify it for the [personnel recovery] role."⁶

The Osprey is a hybrid between fixed-wing and rotary-wing aircraft, enabling it to execute missions that would normally require



Among the Army, Air Force, Marine Corps, and Navy, the Air Force is the only military branch that has assets dedicated primarily to personnel recovery. The other service branches do train some of their units to perform rescue missions; for example, the Marines have Tactical Recovery of Aircraft and Personnel teams. However, when the US military mobilizes and deploys troops en masse, the

[and] can mitigate the operational and political costs created when an adversary exploits isolated personnel to generate propaganda, gain intelligence, or restrict their physical freedom of action or maneuver."⁶ Sterr further points out that "the increased presence of Americans abroad and the dynamics of irregular warfare require the US to develop an effective [personnel recovery] infrastructure."⁷ Because

both types of aircraft.⁹ Its tilting propellers allow it to take-off and land vertically like a helicopter, but also to fly with the speed, range, and efficiency of a fixed-wing turboprop. This combination of characteristics gives the CV-22 the capabilities to travel at distances and speeds that a helicopter could not, and to land in locations that a fixed wing aircraft could not. The newer CV-22 has advanced avionics systems and terrain following radar for bad weather conditions, both of which aid the situational awareness of the crew.¹⁰

The CV-22 is similar in size to the workhorse HH-60. This hybrid aircraft possesses a wingspan of 84 feet and 57 feet long, with a propeller blade diameter of 38 feet for each propeller. In comparison, the HH-60 has a rotor diameter of 53 feet, and length of 64 feet. However, beyond the dimensional similarities, the CV-22 and HH-60 have little in common. Maximum vertical take-off weights for the CV-22 and HH-60 are 52,870 pounds and 22,000 pounds, respectively. If the CV-22 does a rolling take-off, it can carry 60,500 pounds. Both aircraft's flight crews consist of two pilots and two crew chiefs. The CV-22 can carry twenty-four troops in seats or thirty-two on the floor while the HH-60 carries only twelve troops. The CV-22 cruises at 241 knots, 82 knots faster than the HH-60, and has a ceiling of 25,000 feet, 11,000 feet above the HH-60's ceiling. While both aircraft have refueling capabilities, the CV-22's unrefueled range is nearly twice that of the HH-60's approximately 500 nautical miles.¹¹

Besides the capability to fly at a high ceiling, the CV-22 can climb rapidly out of range of dangerous

rockets and automatic weapons that pose the greatest threat to helicopters. Also, Special Operations Command has stated that

is attached to the CV-22—at \$89 million, it is much more expensive than the \$40 million HH-60.¹⁵ The Air Force also has a much smaller

...the CV-22 is 75 percent quieter than rotary-wing aircraft... It can race in and out of battle going twice the distance, at almost twice the speed, carrying double the payload.

when the propellers are rotated forward, the CV-22 is 75 percent quieter than rotary-wing aircraft, an attribute useful for either clandestine or recovery missions.¹² The CV-22 is certainly a formidable aircraft. It can race in and out of battle going twice the distance, at almost twice the speed, carrying double the payload, as the HH-60.

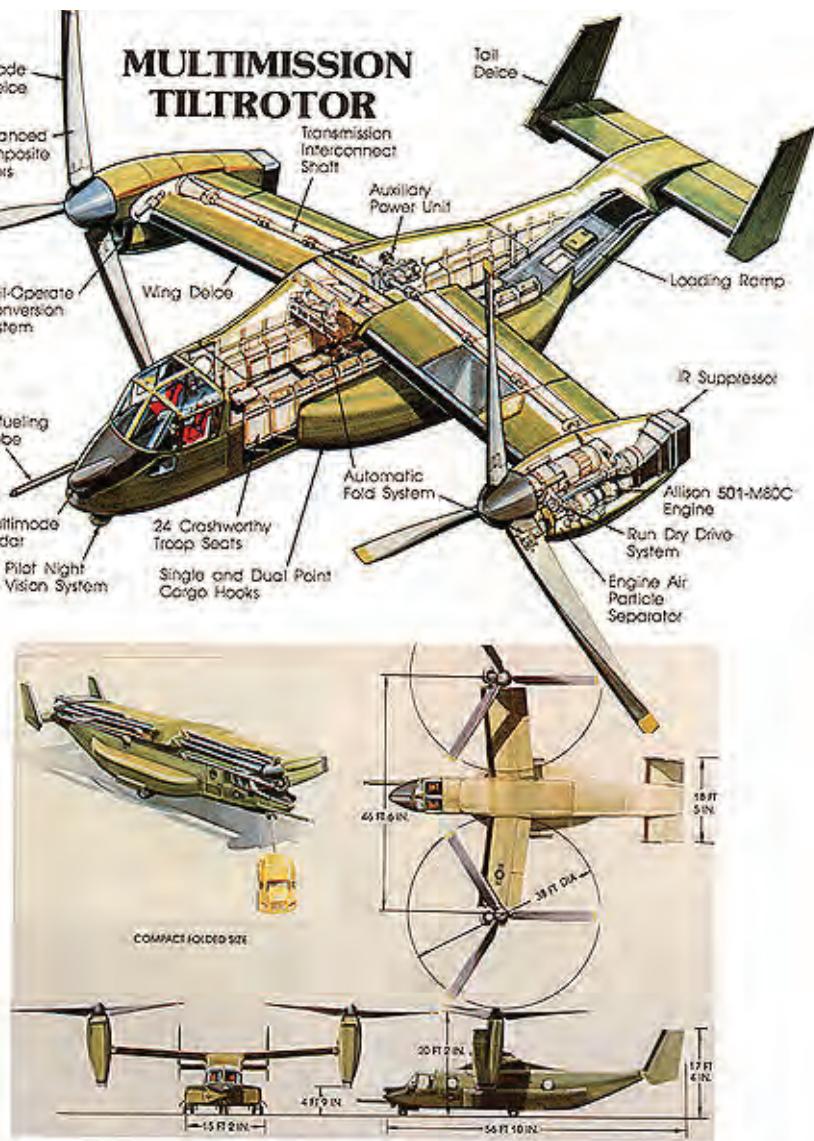
Despite its strengths, the CV-22 is not without its shortcomings. A project in the works since the late 1980s, the CV-22 has been harshly scrutinized following deadly crashes caused by the tilt-rotor technology and doubts have been expressed about its ability to perform key helicopter maneuvers. Groves states, "in the event of a dual engine failure, the [aircraft] settles much faster than a normal helicopter, making autorotational descent and landing extremely difficult."¹³ The CV-22 also lacks the kind of armament normally seen on comparable aircraft: it only has one tail-mounted machine gun instead of two door-mounted machine guns. This lack of armament, combined with a poor ability to autorotate, makes leaders hesitant to take the aircraft into combat zones.¹⁴

Although the Air Force has gained invaluable experience with the CV-22 while conducting special operations missions in Iraq and Afghanistan, the hybrid aircraft is still less battle-proven than the older HH-60. A high-price tag

fleet of only 17 CV-22s, which are used solely by Air Force Special Operations Command, compared to nearly 100 HH-60s. Regardless, the CV-22 has exceptional capabilities that can bridge gaps left by the HH-60s, and the Air Force could at least augment its personnel recovery forces with this capable hybrid aircraft.

Operating Incognito

The ever-changing battle-spaces encountered today demonstrate that American troops will deploy to myriad environments. Altitude, terrain, population, and other factors contribute to how effective an aircraft is for a particular mission. Operations in high mountains, such as those in Afghanistan, can unnecessarily hinder a mission if the aircraft is nearing its ceiling. A helicopter, while the best choice for recovery where there is no room for a fixed-wing aircraft to land, struggles at high altitudes. Thick forests, hills, and other natural obstacles restrict the length of runways making it difficult for refueling aircraft to have access to deployment locations. In remote locations, unless aerial refuel capabilities are at hand, helicopters cannot travel the necessary distances to execute missions. Indigenous populations may be loyal to Americans or they may side with the enemy; in the latter situation, a loud, overly-conspicuous aircraft draws unwanted attention to the



CV-22 Osprey

already high-stress recovery. These factors further demonstrate the need for a wider selection of aircraft that are able to mitigate the fog and friction of combat.

The CV-22 helps to mitigate these functions. It has an operating ceiling comparable to that of a fixed-wing aircraft, so it can fly at the hazardous altitudes in mountainous terrains. The longer range of the CV-22, to an extent, solves the refueling problem, and its quieter engines draw less attention. However, the CV-22 is still very obviously a military aircraft, which, depending on the mission, will not always constitute the most

preferable platform. Fortunately, there is a solution to the problem of unwanted visibility: light-weight, fixed-wing aircraft.

Currently, the only fixed-wing platform dedicated to personnel recovery is the HC-130 King. The Air Force has thirty-six such aircraft divided between active duty, reserves, and air guard. This variant of the C-130 provides support and refueling capabilities for personnel recovery forces. The HC-130 is much larger than the CV-22 and the HH-60, measuring 98 feet long with a wingspan of 132 feet, and carries a payload of 34,000 pounds. This fixed-wing aircraft has a much

longer reach than the rotary-wing platforms—4,000 miles with a ceiling of 33,000 feet at a speed of 251 knots.¹⁶ A 6000-foot long runway is the minimum distance needed for take-off, and although the HC-130 can land on a strip 3000 feet long, that point is moot if it cannot take-off again.¹⁷ During landings, every C-130's engines go in reverse and make a good deal of noise, which draws unwanted attention to the aircraft. This attention could increase the risk of a rescue mission. The HC-130's size and noise levels do not make it the most desirable aircraft when discretion is the better part of valor.¹⁸

Captain Kyle Porter, an Air Force combat systems specialist, argues a personnel recovery squadron that includes light-weight, fixed-wing aircraft among its assets can more effectively accomplish a wider range of missions.¹⁹ Porter offers the following example: if a remotely piloted aircraft with a sensitive payload goes down in Africa, it is most effective to send a recovery team on a light-weight, inconspicuous aircraft. Locals are accustomed to seeing small aircraft carrying hunters, doctors, and explorers, so that a lightweight aircraft landing on a dirt road is likely to go unnoticed.²⁰

Adding to their appeal, light-weight aircraft also require significantly less distance for take-offs and landings. The smallest aircraft proposed by Captain Porter, the A-1C, needs only one pilot, 500 feet for take-off and 200 feet for landing. The largest light-weight aircraft, the DHC-6 Twin Otter, can also be flown by only one pilot and requires just 1200 feet for take-offs and landings. Light-weight aircraft can also be employed on mis-

sions that normally fall under the HC-130s responsibility: “overland and water search; light airdrop or resupply; communication relay, spotting or marking isolated persons; low visibility insertion or extraction; nontraditional intelligence, surveillance, and reconnaissance; on-scene commander; and humanitarian relief.”²¹

The major disadvantage of using a lightweight aircraft is its significantly reduced payload. An A-1C carries only 925 pounds; the DHC-6 carries 3,250 pounds. The lighter, smaller aircraft can go more places and draw less attention at the cost of carrying smaller payloads. Still, these light-weight aircraft have impressive ranges for their diminutive sizes. The A-1C can fly 800 miles with a ceiling of 20,000 feet going 113 knots.²² Depending on whether an auxiliary fuel tank is onboard and the size of the payload, the DHC-6

reach \$4,800 an hour.²⁵ A Twin Otter costs significantly less at \$300 an hour.²⁶

The Alternatives

Given the Air Force’s need for a more effective personnel recovery inventory and the capabilities of the CV-22 and the lightweight, fixed wing aircraft, there are two different alternatives the Air Force can pursue. The first, more costly, alternative offers the widest selection of assets:

Purchase CV-22s specifically dedicated to personnel recovery and invest in various lightweight aircraft. If the Air Force possesses a diverse inventory of aircraft dedicated to personnel recovery, it can more likely conduct virtually any rescue scenario in any location. As Captain Porter says, “having an option to tailor aircraft types and deployment footprints to match the operating environment can enhance mission effectiveness, decreasing risk from threats and realizing monetary and logistical savings.²⁷

A blended deployment package including HH-60s, CV-22s, HC-130s, and lightweight, fixed-wing aircraft would provide the most comprehensive coverage for a wide range of potential personnel recovery missions.

has a range of 644-903 miles with a ceiling of 25,000 feet, also going 113 knots.²³

Because of their small size, these lightweight aircraft carry two other major advantages: low price tags and lower operating costs. The Air Force is being forced to do more with less. When possible, it makes more sense to use a smaller and cheaper aircraft to perform a rescue conserving valuable resources. Most light-weight, fixed-wing aircraft cost no more than \$500,000.²⁴ Porter points out that fuel costs for an HC-130 can

low-impact rescues, the light-weight, fixed-wing assets make the most sense, thereby permitting rotary-wing aircraft to remain on alert for more hazardous, complicated missions. Essentially, the unique strengths of one asset in the blended deployment package serve to offset the weaknesses in its sister platforms. This maximized combination of dedicated personnel recovery assets is a highly efficient solution for enhancing and modernizing the Air Force’s personnel recovery aircraft inventory.

The second alternative the Air Force could pursue is to simply purchase a variety of lightweight, fixed-wing platforms to augment the current inventory of HH-60s and HC-130s.

Although the CV-22 offers very attractive qualities for personnel recovery missions, the time-proven HH-60 can accomplish most of the missions the CV-22 would undertake. The Air Force already compensates for the HH-60’s shorter range with aerial refueling services provided by HC-130s. The HH-60 is a safer, considering its ability to autorotate, though it is also aging in comparison to the CV-22. Lightweight, fixed wing aircraft can ease the load on HH-60s by carrying out inconspicuous rescues in low-threat environments. If it purchases only lightweight aircraft, the Air Force can obtain a greater number of assets to cover different areas and augment current personnel recovery forces than if the same amount of money was spent to purchase both CV-22s and light-weight platforms. Buying only lightweight, fixed-wing aircraft gives the Air Force the largest number of rescue assets for personnel recovery, though operat-

A blended deployment package including HH-60s, CV-22s, HC-130s, and lightweight, fixed-wing aircraft would provide the most comprehensive coverage for a wide range of potential personnel recovery missions. Given the unique capabilities of these various platforms, vital rescue missions in different conditions could be conducted with a greater sense of confidence and higher probability of success. The fuel-hauling HC-130 could transport supplies to forward locations from which the lightweight, fixed-wing platforms could operate. For low-visibility,

ing range remains an obstacle for reaching forces deep in enemy territory.

Of the two possible alternatives, the author suggests the Air Force select the first. How the Air Force acquires the new CV-22s and lightweight, fixed-wing aircraft is also important. The Air Force should purchase the CV-22s and the lightweight aircraft in equal proportions every year so as to have a well-rounded and balanced personnel recovery force. Focusing on only one or the other would unnecessarily create gaps in capability. While augmenting current assets solely with lightweight platforms would be the cheaper option, the CV-22's range and STOL capabilities are invaluable and should be applied to personnel recovery.

Because of the amount of time it will take to create a full-strength personnel recovery inventory in the Air Force, special operations forces units that possess CV-22 assets should, when possible, assist rescue forces. As a corollary, it would be mutually beneficial if personnel recovery forces assisted other organizations in their assigned missions. Otherwise idle personnel recovery aircraft assets could be used to move troops, deliver supplies, and aid indigenous populations. In peacetime, personnel recovery forces can maintain their skills by assisting victims of natural disasters and by conducting search and rescue missions for lost hikers or skiers. Maintaining individual and crew proficiency is just as important as strong rescue platforms. Accordingly, recovery forces should not idly sit by when opportunities are at hand to practice their skills.

Conclusion

Personnel recovery is a very high priority when the US military goes to war. People are precious, and the US seeks to mitigate the risks that its fighting men and women will be captured and exploited.²⁸ Nevertheless, every military operation involves a certain degree of danger, and just because there are significant threats to personnel safety does not mean that the US will never deploy troops. Therefore, personnel recovery is an important mitigating factor to the dangers posed by combat.

The American people rely on commanders to bring home their family members, friends, and loved ones, and the US does not passively allow terrorists to abuse captured Americans. The US Air Force thus requires the most effective possible personnel recovery force. Purchasing new personnel recovery aircraft will be expensive, but it is likely the US will continue to be engaged in conflicts around the world. When its most valuable assets are in danger, the US cannot afford to be without the most robust and versatile inventory possible. Although the current fleet of HH-60s and HC-130s are presently considered adequate for accomplishing personnel recovery missions, Air Force capabilities will be significantly enhanced by the acquisition of new aircraft that can more effectively perform these strategically significant tasks, particularly as the US finds itself in more remote regions like Afghanistan.

¹ Giulio Douhet, *The Command of the Air*, trans. Dino Ferrari (Washington: Office of Air Force History, 1983), 5.

² John Marshall Groves, "A Combat Search and Rescue (CSAR) Role for the CV-22: It's Coming, Get Ready" (master's thesis, Marine Corps Command and Staff College, 2008), 5.

³ Chairman, US Joint Chiefs of Staff, *Personnel Recovery*, final coordination, Joint Publication (JP) 3-50 (Washington, DC: CJCS, 5 January 2007), I-1.

⁴ JP 3-50, *Joint Doctrine for Personnel Recovery* (Second Draft), (Washington, DC: Office of the Joint Chiefs of Staff, 11 May 2005), I-1.

⁵ JP 3-50, *Personnel Recovery*, (final coordination copy), I-1.

⁶ Chad Sterr, "Strategic Rescue: Vectoring Airpower Advocates to Embrace the Real Value of Personnel Recovery," *Air & Space Power Journal* 25, no. 3 (Fall 2011): 26-27.

⁷ Ibid, 29-30.

⁸ Groves, *A (CSAR) Role for the CV-22*, 16.

⁹ US Air Force, "CV-22 Osprey," September 15, 2011, under "Factsheets," <http://www.af.mil/information/factsheets/factsheet.asp?id=3668>

¹⁰ Groves, *A (CSAR) Role for the CV-22*, 17.

¹¹ US Air Force, "HH-60G Pave Hawk," October 20, 2011, under "Factsheets," <http://www.af.mil/information/factsheets/factsheet.asp?id=107>

¹² Otto Kreisher, "Finally, the Osprey," *AirForce-Magazine.com*, February 2009, under "Magazine Archive," <http://www.airforce-magazine.com/MagazineArchive/Pages/2009/February%202009/0209Osprey.aspx>

¹³ Groves, *A (CSAR) Role for the CV-22*, 17.

¹⁴ Ibid, 18.

¹⁵ US Air Force, "CV-22 Osprey," September 15, 2011, under "Factsheets," <http://www.af.mil/information/factsheets/factsheet.asp?id=3668>

¹⁶ US Air Force, "HC-130P/N King," January 1, 2010, under "Factsheets," <http://www.af.mil/information/factsheets/factsheet.asp?fsID=106>

¹⁷ Kyle J. Porter, "Air Force Fixed-Wing Rescue: A Multifaceted Approach

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18 Ibid, 42.

19 Ibid, 44.

20 Ibid, 37.

21 Ibid, 44.

22 Aviat Aircraft, “Husky A-1C,” Aviat Aircraft Inc, <http://www.aviataircraft.com/hspcs.html>

23 US Department of Commerce, “DeHavilland Twin Otter (DHC-6)”

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24 Porter, “Air Force Fixed-Wing Rescue,” 43.

25 Ibid, 39.

26 Dornier Seaplane Company, “Direct Operating Costs,” Dornier Seaplane Company, <http://www.dornierseaplane.com/content/direct-operating-costs>

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28 The US is fearful of experiencing another Mogadishu. The Black Hawk Down incident and capture of CWO Mike Durant scared the US out of Somalia in the early 1990s and the US has been apprehensive of committing ground forces to any volatile military operations since then. A Modern Cuban Missile Crisis?

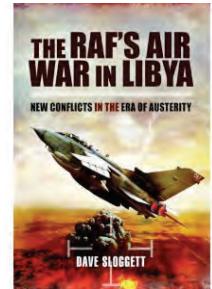


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Book Review

War Made New: Weapons, Warriors, and the Making of the Modern World, by Max Boot

REVIEWED BY EDWARD BOYLAN

Max Boot's work, *War Made New: Weapons, Warriors, and the Making of the Modern World* is a cumulative composition of the development and history of warfare. The text begins with the gunpowder revolution, progresses

using major historical benchmarks and more to look at the future, drawing the reader into the environment of the time before stating his case, and finally, by basing his claims upon historical facts available from the appropriate era.

Max Boot's work "argues that the past five centuries of history have been marked not by gradual change in how we fight but instead by four revolutions in military technology—and that the nations who have successfully mastered these revolutions have gained the power to redraw the map of the world."

through the industrial revolution and beyond to today's information revolution, and concludes with how the past affects the present along with a peek into potential future military innovations and their impacts. Boot begins each of his chapters with an account of a particular battle in history. For example, his first chapter, "Sail and Shot: The Spanish Armada," opens with the Spanish catching their first glimpse of the English coastline on 29 July 1588.¹ His method of interweaving storytelling into factual accounts supports the compelling arguments, which builds upon the overall theme of the book in each of his chapters and makes for a captivating read throughout his text. *War Made New* is an all-encompassing overview of the development of military history, breaking the last five hundred years into the four revolutions mentioned above,

According to the Council on Foreign Relations, Max Boot's work "argues that the past five centuries of history have been marked not by gradual change in how we fight but instead by four revolutions in military technology—and that the nations who have successfully mastered these revolutions have gained the power to redraw the map of the world."² Boot's use of these breaks in the past five centuries serves to bring attention to four major technological revolutions that he argues serve as the organizing standard for military history. Boot's breakup of the past makes an interesting read as he concludes historical battles were won or lost not only by having technology, but knowing how to properly harness it.

Boot's practice of opening each chapter with a captivating intro draws the reader in as he out-

lines his main points. According to the article, "Review of War Made New," Boot "provides the background and detailed descriptions of actual combat of several campaigns to demonstrate the effect of intelligent adoption of the new technologies produced in each of the four revolutions."³ By drawing the reader in, Boot is able to narrate freely while still engaging and maintaining interest. From the defeat of the Spanish Armada to the German Blitzkrieg of WWII, Boot uses numerous examples of one adversary being able to effectively adapt new technology or strategy to become victorious over equal, and sometimes superior, adversaries. Boot's storytelling combined with factual accounts from various battles across history are accompanied by easy to understand concepts that almost always universally apply, even in different centuries of warfare.

From his book, *The Iraq Wars and America's Military Revolution*, author Keith L. Shimko includes Boot's sentiments about the US's easy campaign against Saddam Hussein in Iraq during 2003. As Boot works through his chapters from the renaissance to modern military history, he uses the volley of available information to further substantiate his thoughts on the

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need for militaries to not only adapt new technology, but also to employ it effectively. Shimko quotes Boot's text directly to comment on the US's rapid race to Baghdad in the Second Iraqi War,

The eminent military historian John Keegan... remarked that in taking Baghdad in less than three weeks "the Americans achieved a pace of advance unprecedented in history".... Victor Davis Hanson agreed that "by any fair standard of even the most dazzling charges in military history, the Germans in the Ardennes in the spring of 1940, or Patton's romp in July of 1944, the . . . race to Baghdad [was] unprecedented in its speed and daring and in the lightness of its casualties." Max Boot was the more succinct: "No army had ever travelled faster with fewer casualties."⁴

Unfortunately, some argue that Boot's use of facts and figures sometimes takes shortcuts. According to one author writing in a "Review of War Made New," the "eminent historian William McNeill, criticized the book because he felt it omitted important events and failed to analyze crucial non-military aspects of the events it did treat."⁵ Though pointing out flaws in Boot's work, these can be countered by his opening chapter statement: "I will not attempt to challenge...a number of prominent recent works that have sought to explain the [entire] course of human development.... Rather than attempting to supplant them, this book will supplement them by highlighting the importance of certain vital military developments in the making of the modern world."⁶ What Boot is saying here is that he does not mean to blot out longer, more detailed works on the subject, but to add to them. So despite the criticism, I believe that Boot successfully defends himself by stating he is not looking to write

an all-encompassing cumulative history of the events surrounding all the examples in his depictions of famous battles. By stating this limitation up front, Boot achieves his end goal. He does so by demonstrating that throughout history, nations that have evolved and correctly realized the uses and limits of their military technology have achieved victory over their adversaries.

In conclusion, War Made New is an easy to read survey of key advancements in military history. Boot's maintains the reader's interest breaking the last five hundred years of history into four sections, divided by major historical benchmarks, allowing the reader to clearly understand the background of the battles he is describing. In addition to his framing, he also paints a clear picture for the reader by narrating individual battles, describing them from the perspective of someone actually there, before explaining the specific actions of the battle. In this way he achieves a novel-esque style of writing. This technique only gets more intriguing as his book progresses towards the recent military actions of the wars in Iraq and Afghanistan. Max Boot's work serves as a basic overview of military history for the last five hundred years, and does so with clear validity. Boot makes persuasive arguments about how technology may have won the battle, but only the consistent adaptation and trial and error method of learning boundaries of technology win in the end. War Made New is an excellent read for anyone looking to see how the US military got where it is today and even catch a glimpse of where it may be headed

in the future.

1 Max Boot, *War Made New: Weapons, Warriors, and the Making of the Modern World*. New York, NY: Gotham, 2007.

2 War Made New, Review. Council on Foreign Relations. Web. 13 Apr. 2011, <http://www.cfr.org/information-warfare/war-made-new/p10313>.

3 "Review of War Made New: Weapons, Warriors, and the Making of the Modern World, by Max Boot." Rhapsody in Books. Wordpress.com, 4 Apr. 2011, <http://rhapsodyinbooks.wordpress.com/2011/04/11/review-of-%E2%80%9Cwar-made-new-weapons-warriors-and-the-making-of-the-modern-world%E2%80%9D-by-max-boot/>

4 Keith L. Shimko, *The Iraq Wars and America's Military Revolution*. New York, NY: Cambridge Univ. Press, 2010.

5 "Review of War Made New..."

6 Boot, 10.

Man's flight through life is sustained by the power of his knowledge.